

SEPTEMBER

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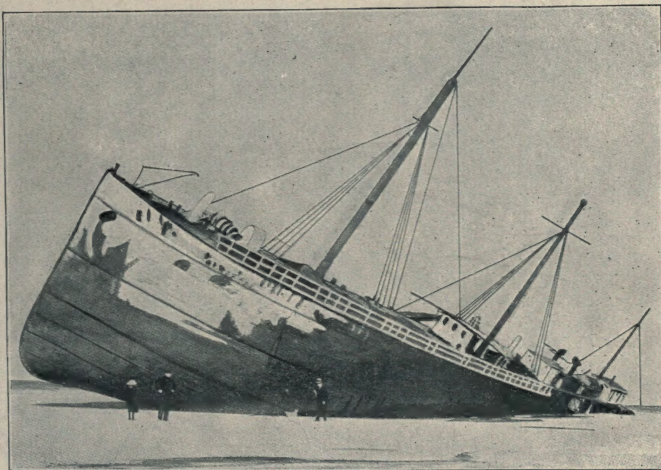
Physical &
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1904

THE LIFE-SAVING SERVICE

By

HORACE L. PIPER



Wreck on Long Island Coast

Vol. II

No. 1

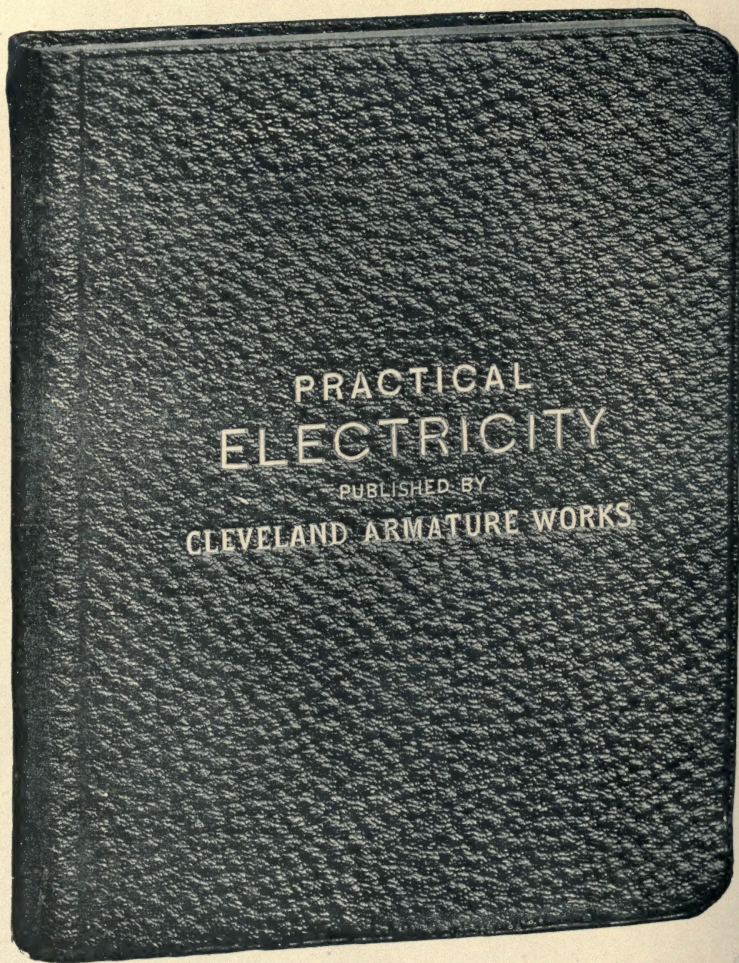
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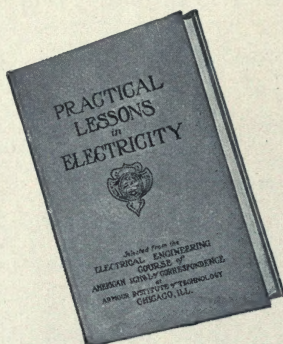


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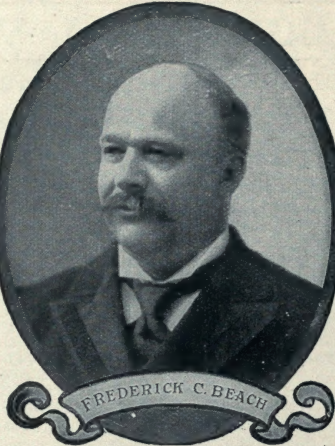
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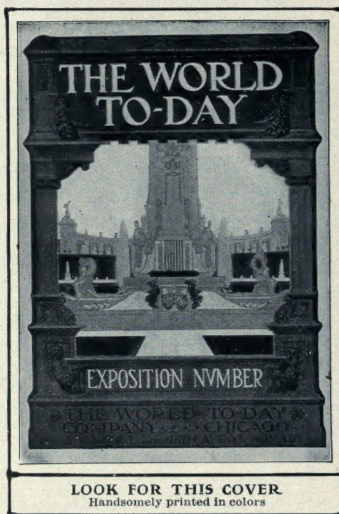
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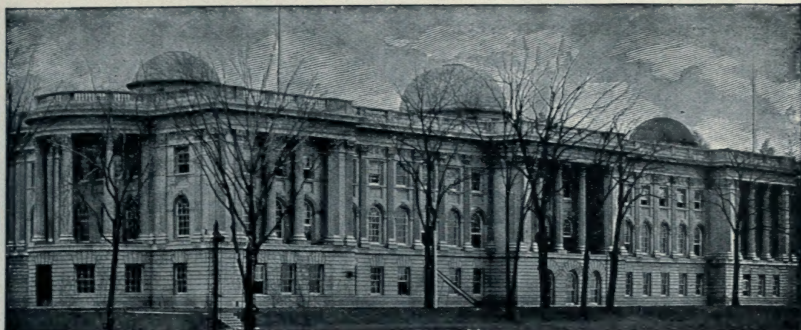
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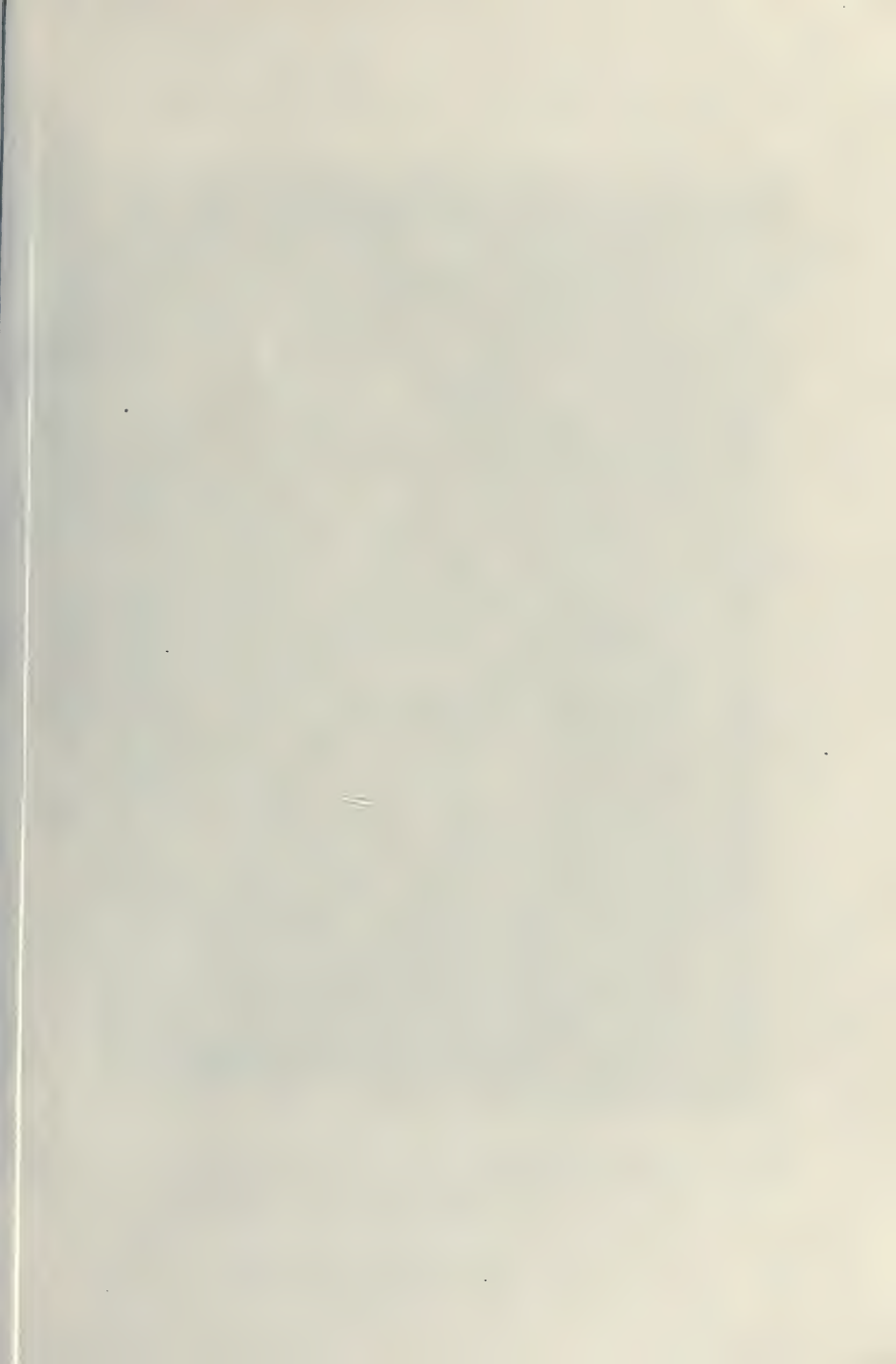


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(See Page 60)

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The Technical World

Volume II

SEPTEMBER, 1904

No. 1

The Life-Saving Service

Inception, Development, and Achievements

By HORACE L. PIPER

Assistant General Superintendent, United States Life-Saving Service

ORGANIZED EFFORT for the rescue of life from the perils of the sea is decidedly modern. In England, the foremost maritime nation of the world, it developed no earlier than here.

Origin and Early Growth

Although the Humane Society of Massachusetts established houses of refuge on the coast of that Commonwealth as early as 1789, and began placing lifeboat stations there in 1807, the Government of the United States, strange to say, took no hand in life-saving affairs until 1847, when an appropriation of \$5,000 was made for furnishing lighthouses on the Atlantic coast with means for assisting shipwrecked mariners. The next year, Congress appropriated \$10,000, to be expended on the coast of New Jersey, between Sandy Hook and Little Egg Harbor. The importance—or unimportance—of the stations established with the help of this paltry sum, may be estimated from the fact that eight stations were erected and put in working order. They were little more than rough board shanties 16 by 28 feet, scantily equipped. An appropriation of \$20,000, made in March, 1849, proved sufficient to build and equip eight stations on Long Island, and six on

the New Jersey coast between Little Egg Harbor and Cape May.

Among the appliances furnished was a life-car, which was destined to be tested soon and successfully. During a savage storm on the night of January 12, 1850, the emigrant ship *Ayrshire* stranded at Squan Beach, having on board many people for those days of small things. They were more than 200; and, since the surf ran so high that no boat could be launched, a line was shot out from a mortar, and the life-car, with a rope attached to each end, was then drawn forth to the ship and back to the land many times, finally rescuing the entire ship's company. Instantly the invention of the car came into hot dispute between Mr. Joseph Francis and Capt. Douglas Ottinger, it having been constructed under the supervision of Mr. Francis, a practical machinist, with the coöperation of Captain Ottinger, of the Revenue Cutter Service, who had charge of the life-saving stations. Francis lived to be 92 and Ottinger to be 94 years old, but neither could prove his claim. In 1859 Congress recognized that of Ottinger, and voted him \$10,000 in consideration of his services to humanity. Twenty-eight years afterwards, another Congress awarded a huge gold medal to Mr. Fran-

cis for the same invention. The car which bred the famous quarrel has been seen by millions of persons at our various national and international expositions, and, with the shot fired on the occasion above mentioned, is now on exhibition at the Louisiana Purchase Exposition in St. Louis.

From 1848 to 1853 the Life-Saving Service drifted along very much like a rudderless craft, and in 1853 Congress failed to adopt a pending measure to pro-

partially awoke to the necessities of the situation, and immediately provided for two superintendents (one for Long Island and one for New Jersey) at a compensation of \$1,500 each per annum, and a keeper for each station at a salary



LIFE-CAR AND OLD-TIME MORTAR.

mote its efficiency. Many heartrending disasters had recently occurred; but in May, 1854, the ship *Powhatan*, carrying between 300 and 400 persons, was lost on the Jersey coast, and, although she lay only about 200 feet off shore, everyone aboard perished. This appalling calamity so aroused the country that Congress



FIRST UNITED STATES LIFE-SAVING STATION.

of \$200. Crews were left to be picked up as best they might whenever the awful necessity should arise. In this fashion things continued until 1869, when Mr. Haight, Representative from New Jersey, tried to secure a provision of law allowing the employment of permanent surfmen. He was defeated; but fortunately, through the vigorous and skilful efforts of Hon. S. S. Cox, a substitute was adopted, authorizing crews at alternate stations. That was something, and it "broke the ice" for the passage of subsequent legislation.

Even with these improvements, the Service still remained deplorably inadequate. It lacked thorough organization and zealous guardianship. The Revenue Cutter Service, of which the Life-Saving establishment was only an adjunct, was itself sadly in need of reformation; and to that end, in February, 1871, Mr. Sumner I. Kimball was appointed Chief. Politics had honeycombed the whole fabric; and, with regard to the Life-Saving branch, there was an especially sorry state of affairs. An inspection along the coast showed the stations too remote from one another; the houses often filthy, some in ruins; the outfits frequently lacking such prime requisites as powder, rockets, and shot-lines; the apparatus

rusted out or incomplete; and a general unfitness among the keepers. The new Chief promptly resolved that professional fitness and not politics should henceforth dictate appointments, and that the beaches should be patrolled by night, as well as by day, in thick weather. The refreshing result was that during the next season not a single life was lost within the scope of station operations.

Made a Separate Bureau

The Service remained a part of the Revenue Cutter Division until 1878,

ing establishment was thoroughly vindicated, and, by Act of June 18, 1878, organized into a separate bureau. Mr. Kimball was nominated, and on the same day unanimously confirmed, to be General Superintendent, to which position he was at once transferred from the Revenue Cutter Service.

Districts, Stations, and Personnel

The coasts of the United States are now divided into thirteen Life-Saving Districts, comprising 273 stations, nine of which are simply houses of refuge



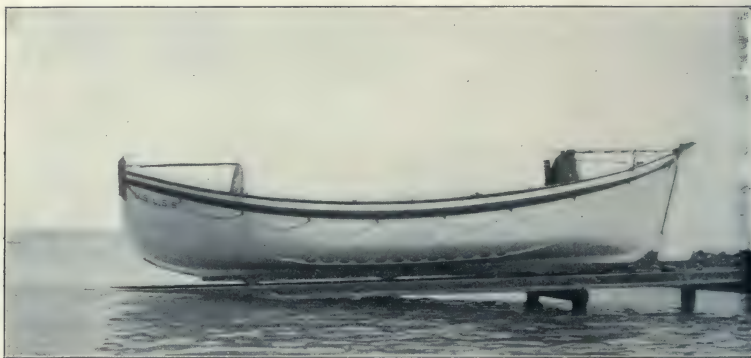
STATION, SURFBOAT AND BOAT-WAGON.

when the wreck of the *Metropolis* occurred on the coast of North Carolina, involving the loss of 85 lives, and, soon thereafter, the wreck on the same coast of the U. S. war vessel *Huron*, in which 98 men perished. These overwhelming shocks at first provoked wrathful censure of the Life-Saving Service; but, as to the *Huron*, it was speedily disclosed that she was lost while the Life-Saving stations were closed according to law. With regard to the *Metropolis*, it appeared that Congress had failed to place stations in that vicinity, as had been urged by the Chief of the Service. The outcome of the whole matter was that the Life-Sav-

where only a keeper is employed. The Keepers (Captains) of the stations having crews receive \$900 per annum; and the members of the crews (surfmén), \$65 per month. Keepers must not be less than 21 years old when enlisted, surfmen not less than 18, and neither class more than 45. Keepers are promoted from the surfmen, and superintendents from the keepers. Outsiders are eligible only to the grade of surfmen, and the prospect of promotion therefore furnishes strong incentive to faithful conduct. The crews are drilled every day except Saturdays, in some of their duties, among which are resuscitation of the ap-

parently drowned, and the use of the International Code of Flag Signals, and of the "wigwag" system, in which the men are extremely proficient. The crews also

breeches buoy, and the life-car. The boats may be divided into two classes—surfboats and lifeboats. The surfboat, although practically a lifeboat, is less



LIFEBOAT ON LAUNCHING CARRIAGE.

constitute a permanent part of the Naval Coast Guard for war purposes. A mutual benefit association, which they have organized, promotes contentment, and affords an inducement for them to continue in the Service. They are a superb set of men morally, physically, and professionally, that cannot be surpassed either by the Army or the Navy, here

than one-fourth the weight of the latter, and therefore is especially adapted to flat beaches. As regards safety, a comparison with other boats, made some years ago, showed that during the eighteen preceding years the surfboats had landed 6,735 persons from wrecked vessels; and that during that time only 14 capsize took place, in which 41 persons perished



A WRECK ON THE LAKES.

or elsewhere. This is the testimony voluntarily given over and over again by the highest officers of the naval and military establishments.

Lifeboats and Surfboats

Many devices are used in life-saving; but the ultimate means are the boat, the

—27 of the Service, and 14 shipwrecked. The splendid achievements of the English lifeboats are known world-wide; and yet, during the period named, those boats capsized 21 times, with a loss of 68 boatmen and 7 shipwrecked persons. The number of surfmen lost from our boats

was 1 in 1,744, while the number from the English lifeboats was about 1 in 850.

Where the water is sufficiently deep to effect a launch, lifeboats are used. They are self-bailing and self-righting, from 26 to 34 feet in length, capable of carrying sail, and will support a very large num-

signed for the Life-Saving Service by Colonel Lyle of the Army, is a pretty, little bronze cannon weighing less than 200 pounds, very accurate, and capable of carrying more than a third of a mile. By means of the shot-line, the shipwrecked haul out what is called the



FIRING THE LYLE GUN.

ber of people. The way a lifeboat bails itself is by means of relieving tubes running down from the deck through the bottom of the boat. When a sea dashes on board, the deck being higher than the outside water, that taken on board runs down the relieving tubes by force of gravity, and the boat is thus constantly kept free. Some of our surfboats are also self-bailers and self-righters. The self-bailing quality is probably the best feature a boat can have; without it she is liable to be swamped at any moment, and is always handicapped.

The Breeches Buoy

The breeches buoy apparatus, when in operation, is simply a rope suspension bridge between the ship and the shore. The Lyle gun first throws over the wreck a projectile, with a small but very strong cord attached. This gun—the only piece of ordnance that shoots to save—de-

signed for the Life-Saving Service by Colonel Lyle of the Army, is a pretty, little bronze cannon weighing less than 200 pounds, very accurate, and capable of carrying more than a third of a mile. By means of the shot-line, the shipwrecked haul out what is called the



STEAMER "PERE MARQUETTE," STRANDED NEAR ENTRANCE TO HARBOR OF LUDINGTON, MICH.

Breeches Buoy in Operation.

shore end is anchored, and set up over a tripod. The breeches buoy is slung to the hawser by a traveler block, and at-

tached to the whip line, by which it is drawn to and from the vessel, bringing to the shore on every home trip one or two

Patrol System

In the old days, tardy information of disasters was often the cause of great

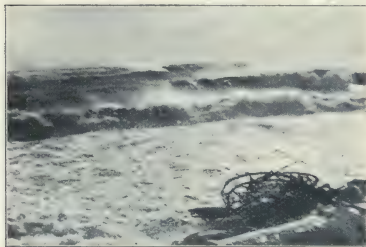


A TYPICAL LIFE-SAVING CREW.

persons. Thousands have been safely landed in this ingenious way when no other was possible.

The Life-Car

The life-car is a little iron boat, covered over, and capable of containing five or six persons. It may be run on the



A VERY HEAVY SURF.

Wreckage from Schooner "Augustus Hunt" Coming Ashore at Quogue, Long Island, Jan. 22, 1904.

hawser, or drawn on the surface of the water. It is entered by a small hatch, which may be fastened from the inside or from without; and it is extremely useful when women and children are among the shipwrecked.

loss of life; but the patrol system has eliminated this horror, wrecks being now discovered within a few minutes after their occurrence, sometimes on the very instant. The patrolman quickly burns his signal—a message of hope to the shipwrecked, and of alarm to the station—and the crew turns out promptly, while the ever-ready telephone summons assistance if need be from neighboring stations. Patrol duty is always arduous, and, in the bad winter weather, is extremely severe and dangerous. The arrangement of the watches is necessarily such that no man ever has a whole night in bed. Quite a large number of patrolmen have perished on the stormy pathway, and a great many have suffered serious injuries; but the inestimable utility of the patrol system has been demonstrated over and over again.

One night in February, 1880, three life-saving crews rescued the crews of four wrecks on the New Jersey coast, without the slightest mishap, while everything and everybody was coated with ice and the weather was pitch dark. In September, 1889, three crews near Cape Henlopen, Delaware, rescued every person (194) from 22 stranded vessels,

and in doing so made use of every known means of saving life from shipwreck—the boat, the breeches buoy, and the life-car. Four crews on the same coast attended 65 wrecks during the years 1888 and 1889, rescuing 499 persons. During the first seven years of the present system on the Jersey coast, there were 180 disasters, involving 1,909 lives, of which only 18 were lost. During the entire history of the present Service on that coast, only one life has been lost of every 133 imperiled.

Heroic Deeds

Many of the rescues have called out most noble acts of heroism. Just before daybreak during a hurricane on the North Carolina coast, patrolman Midgett, alone, two miles away from his station, rescued 10 men, one by one, at the jeopardy of his own life in each instance. On the same coast, volunteers were once wanted to go to a wreck in the breeches buoy, under very desperate conditions. There were 21 surfmen on the beach; and when two were called for, 21 stepped forth and contended to the point of acrimony for the privilege of making that frightful trip. Some years ago, Fred Hatch, of Cleveland, Ohio, made a

from that point saved the lives of two men. At Buffalo, N. Y., three years ago, Keeper Griesser performed one of the most extraordinary feats of swimming of modern times, carrying a life-line, with which he effected an extremely difficult rescue.



MAINMAST AND OTHER WRECKAGE OF AMERICAN SCHOONER "AUGUSTUS HUNT," QUOGUE, LONG ISLAND, JANUARY 22, 1904.

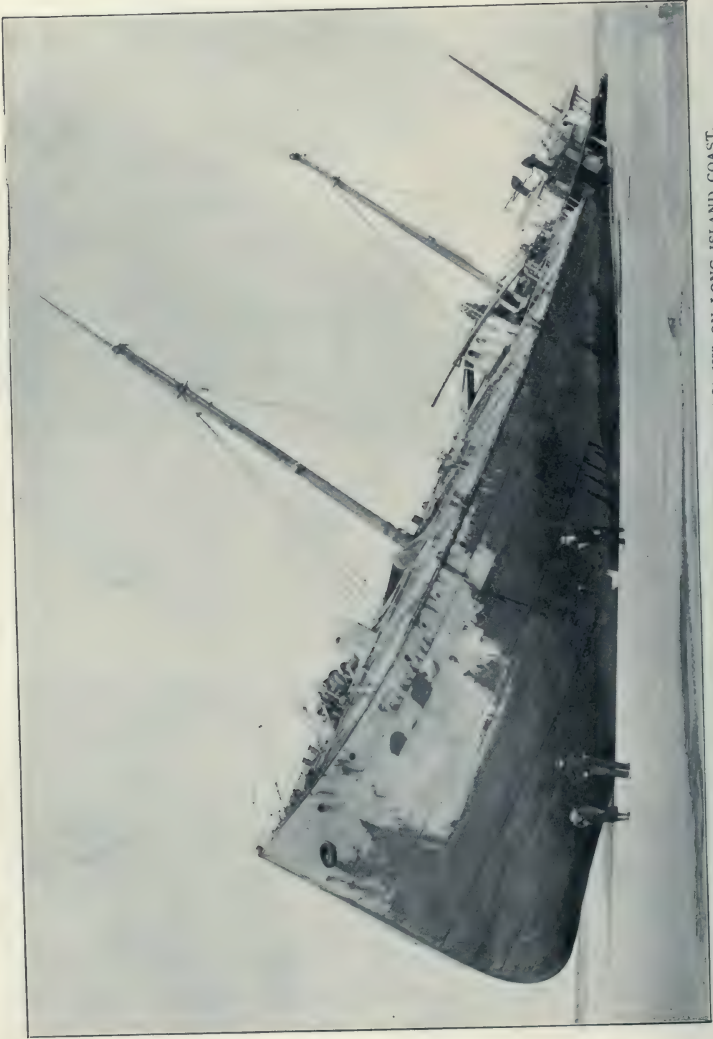
These brave men were awarded life-saving medals of honor, which may be bestowed by the Secretary of the Treasury, not only upon surfmen, but upon "any persons" who endanger their own



AMERICAN BRIG *WATER WITCH*, WRECKED MARCH 19, 1896, ON BRENTON'S POINT, RHODE ISLAND.

mighty leap one dark and tempestuous night, from the main boom of a submerged wreck to the mizzen shrouds, which he succeeded in reaching, and

lives in saving the lives of others in waters over which the United States has jurisdiction. In several instances, women have been the recipients of these honors.



GERMAN STEAMER *GLUCKAUF*, 2,300 TONS, WRECKED MARCH 24, 1893, ON LONG ISLAND COAST.
All aboard were rescued. This picture was taken October 1, 1914, one and one-half years after the wreck.

Among the most noted are Mrs. Martha White, who dragged ashore three sailors in a terrible storm on the Pacific coast; and Ida Lewis, the Grace Darling of

in 100 has been lost; while of property imperiled, to the amount of more than \$210,000,000, over \$166,000,000 has been saved. The cost of maintenance of the



RASMUS MIDGETT.

Surfman, Gull Shoal Station, who rescued ten men at the peril of his life in each instance.



W. W. GRIESSER.

Keeper, Buffalo, N. Y., Station, who carried a line out 500 feet through a terrible sea and gale of wind and rescued a man clinging to piling in Buffalo Harbor.



FRED T. HATCH.

Surfman, Cleveland, Ohio, who made a midnight leap from main boom to mizzen shrouds.

SOME OF THE HEROES OF THE LIFE-SAVING SERVICE.

America, who has saved many lives in the vicinity of Narragansett Bay, where she is now a lighthouse keeper.

The crews of stations comprising 6 or 7 men, dwell in the station houses, which are models of comfort and convenience; and the boat rooms amply accommodate the boats and appliances, which are always ready for instant service. In the exact sense in which we use the words "life-saving station," there is no such thing anywhere else in the world, the so-called stations of other countries being simply boat-houses, without living quarters or permanent crews. Nor is there any other life-saving establishment in the world maintained solely by Government, all save ours being supported wholly or mainly by contribution.

There are now about 2,000 men in the Life-Saving stations of the United States; and these watchful outposts of humanity stretch from Quoddy Head on the North Atlantic to Cape Disappointment on the North Pacific, as well as along the shores of the Gulf of Mexico and the Great Lakes. Under the present system (since November, 1871), the Service has attended 14,076 disasters, involving 102,474 lives, of which only one

Service for the last year was \$1,721,727, which is less than one-fourth the amount of property saved during that time, and



A

B

A—GOLD LIFE-SAVING MEDAL, AWARDED FOR HEROIC DARING.

B—SILVER LIFE-SAVING MEDAL, AWARDED FOR DISTINGUISHED SERVICE.

not so much, by \$200,000, as one-fourth the estimated cost of the latest type of battleship ready for service.

The Drainage System of New Orleans

A Notable Engineering Work that is Transforming the Entire Aspect of this Southern Metropolis

By DAY ALLEN WILLEY

THE CITY of New Orleans has begun a new era in its history, thanks to a public improvement which is one of the most notable of American engineering feats. As a result of this great work, the community at last stands on "dry land" for the first time since it was founded by the French pioneers. For nearly two centuries, the inhabitants of New Orleans have been living on the surface of a great natural sponge. Owing to the topography of the city, there is no natural drainage whatever, and the formation is such that holes dug to a depth of even two or three feet would reach the water that saturated the ground nearly to the surface. Some scientists have believed that the site of the city is a part of the "trembling prairie" which is so extensive in this portion of Louisiana.

Foundations of Mud and Water

As a result of this condition of affairs, the construction of buildings even three stories in height has been a difficult problem, as it was found to be practically impossible to secure a stable foundation for them. In consequence, the great majority of the dwellings have been erected of wood; and the comparatively few structures of brick and stone have been built with great care, to prevent their foundations from settling to such an extent as to injure or destroy the buildings. The history of the Spanish fort at Belize, which was erected near the mouth of the Mississippi river and sank almost completely out of sight, is well known. The walls of the venerable St. Louis Cathedral settled after completion so that its towers crumbled. Among the engineers who realized the problem to be solved in the construction of buildings in New Orleans, was General Beauregard, the architect for the New Orleans Custom

House. It was decided to use granite for this purpose. General Beauregard made a thorough investigation of the site, and calculated on the foundation sinking to a depth of several feet. Realizing that if one portion settled more rapidly than the others, the building would probably be wrecked, he directed the construction in such a manner that the weight was equally divided upon the lower section of the walls. As he had predicted, the building settled consider-

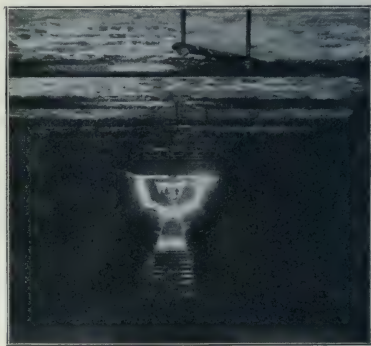


FIG. 1. INTERIOR OF ST. LOUIS STREET CANAL, NEW ORLEANS, IN COURSE OF CONSTRUCTION.

ably; but fortunately all portions sank simultaneously, with the result that several cracks in the walls—which were readily repaired—constituted the principal damage. It might be added that until a year or so ago not a cellar existed under a building in New Orleans; and the atmosphere, so constantly saturated with moisture from the earth, has, in the opinion of physicians, caused much of the sickness prevalent.

Drainage to a Higher Level

When the question of "drying out" the community was agitated, one of the

problems which presented itself was how to get rid of the drainage, for, after an examination of the area to be drained, it was found that all of the water must be forced to a higher level than the site on which the city stands. As is well known, nearly all of the land on which

moving the sewage. At New Orleans mechanical power entirely is employed.

Canals for Drainage and Sewage

The improvement in New Orleans, which was commenced in 1897 under the supervision of Mr. George G. Earl, with Mr. W. C. Kirkland engineer in charge, has progressed so rapidly that a very large section of the city is at last completely served by the drainage canals and pumping stations. In all, about thirty miles of trunk or main canals have thus far been completed, including channels extending beneath the principal thoroughfares, but excluding branches which reach the smaller streets. This network of waterways is so arranged that the adjacent buildings can be connected with them by pipes, affording sanitary facilities of which in the past the city has been almost entirely destitute. The canals



FIG. 2. NASHVILLE AVENUE LINED AND COVERED CANAL, NEW ORLEANS, IN COURSE OF CONSTRUCTION.

the city has been built lies below the surface of the Mississippi river to such an extent that, were it not for the levee protection, the water would rise to the second story of the buildings in the lower portion of the city. To furnish an adequate drainage system, it was necessary to construct a series of canals which would serve nearly 200 square miles, and to connect them with a series of pumping stations of sufficient capacity to force the water into a tributary of the Mississippi, elevating the water to heights varying from 6 to 18 feet according to the levels of the canals. It was calculated that the quantity of rainfall and other surface water to be removed, was so great that it would be necessary to carry it away at a rate of nearly 60,000 gallons each second. In fact, the project has been considered by experts to be one of the most difficult ever attempted by engineers.

The City of Mexico was converted from a plague spot of disease into a healthy city by constructing a tunnel through the mountain side surrounding it. This has been a notable achievement, but the force of gravity has assisted in



FIG. 3. CHARTRES STREET CANAL IN COURSE OF CONSTRUCTION, SHOWING STEAM EXCAVATOR AND ELECTRIC MOTOR FOR OPERATING DUMP CARS.

range from mere ditches 500 feet in length and 3 and 4 feet wide, to waterways nearly 2 miles in length, 40 feet in width, and 12 feet in depth. The latter are really huge tunnels which required no little skill to construct. Owing to the nature of the soil, it was found necessary to support them in many places upon wooden piles, which in turn rest upon plank foundations driven far into

the earth. To prevent leakage, the bottoms of the canals are lined with concrete, while the side walls are of brick.



FIG. 4. CENTRAL POWER STATION, WHERE POWER FOR THE SEVERAL PUMPING STATIONS IS GENERATED.

Those which are constructed beneath the streets (Fig. 1) have roofs formed of steel framework, which in turn support

of the best in the world, and, in some respects, resembles that of Paris. Figs. 2 and 3 show typical scenes during the construction of these canals.

Pumping to Higher Levels

The waterways are divided into eight groups, each being served by a set of pumps operated by electric power. In all, 26 pumps are in service, having a total discharging capacity of 7,600 cubic feet per second, with an average lift of 12 feet. They are connected by a system of wires with the generating station from which all of the power is secured. This building (Fig. 4) is 181 feet in length, 140 feet in width, and two stories high. An interior view is shown in Fig. 5. The building contains an equipment of 7 units, each consisting

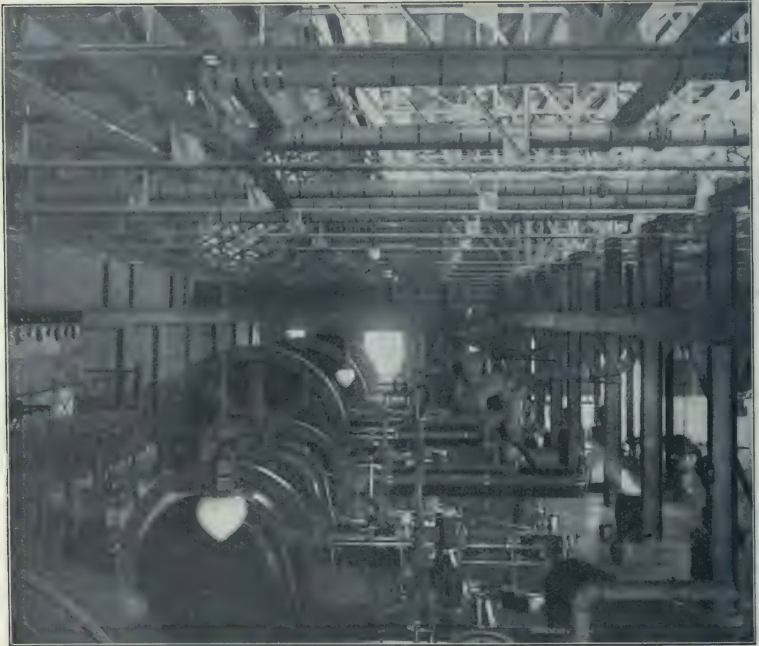


FIG. 5. INTERIOR OF CENTRAL POWER STATION, NEW ORLEANS DRAINAGE SYSTEM.

One-half of engine room is here shown.

brick arches to uphold the roadway. Considering the difficult character of the work, the system is considered to be one

of a steam engine direct-connected to a generator, and each unit developing 2,000 horse-power. Steam is supplied

from a battery of 11 boilers arranged in a separate compartment, the entire set of boilers representing about 15,000

The canals are so arranged that a pumping station of sufficient capacity is connected with each level. This is usu-



FIG. 6. SUCTION BASIN AND PUMPING STATION NO. 7. PARTIALLY COMPLETED.

horse-power. The boilers are of the tubular type, and are provided with chain-grate mechanical stokers. In addition to the generating units and boilers, the station also contains two small steam engines for auxiliary use.

ally located at the terminus of the principal receiving canal in the locality, the water draining by gravity into a suction basin (Fig. 6), from which it is forced by the pumps into a discharge basin (Fig. 7), thence passing through another chan-

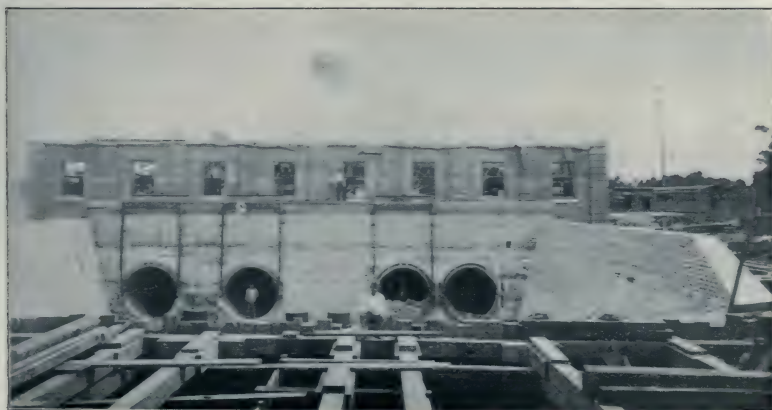


FIG. 7. DISCHARGE BASIN AND PUMPING STATION NO. 7. PARTIALLY COMPLETED.

nel, to be pumped into the outlet canal and finally discharged into Lake Borgne, a large inlet from the Gulf of Mexico, 12 miles east of the city.

Sewerage Below Water-Level

Realizing the need of adequate sewers in connection with the drainage system, a portion of the fund which has been provided is being expended for this improvement. Only a beginning has been made; but about five miles of sewers have thus far been completed, and it is intended to have the principal streets in the 560 miles of thoroughfare that traverse New Orleans, properly seweraged within the next decade. Contracts have already been let for an extensive area. Provision has also been made for an ample supply of pure water, so that the people in future will not have to depend upon wells for their supply of this necessary of life.

New Activity in Building

One of the results of the extraction of the moisture from this great "sponge" upon which the city rests, is the activity in building. Already the business section of New Orleans has undergone a remarkable transformation. Since the principal canals have been completed, it has been found possible, in these districts, to erect buildings of brick, stone, and iron, which compare favorably with those to be found in other large cities of the country; and the area of one-story and two-story buildings appears to be at an end. Contracts have recently been let for a hotel which will be twelve stories high—a remarkable altitude for a New Orleans building. Although this building will contain several thousand tons of steel, the site upon which the structure is to stand has become so firm that architects say it can be built with entire safety and with but little difficulty.



A Quarter-Century of American Central Station Engineering

The Marvelously Rapid Progress in Electrical Engineering which has Revolutionized Industrial Conditions

Part II.

By R. F. SCHUCHARDT, B. S.

Testing Laboratory, Chicago Edison Company

Alternating-Current Systems

SO MUCH for the early development of the direct-current systems, of which the cities cited are characteristic examples. Let us see when the alternating current entered the field. The development of the alternating-current system in America is due largely to Mr. George Westinghouse, who, in 1885, had built at Pittsburg, Pa., an experimental plant to work out the system devised by Gaulard and Gibbs in England. The first commercial result of the Westinghouse investigations, car-

ried on by Shallenberger, Stanley, and others, appeared in the plant installed at Buffalo, N. Y., in November, 1886. The following year, 65 plants, with a total capacity of 125,000 lights, were built; and the increase thereafter was rapid.

With a direct-current three-wire system using 230 volts between outside conductors, it is uneconomical to transmit current much farther than one and a-half miles, because of the prohibitively large amount of copper necessary to keep down the loss in the feeders. The resistance of a conductor varies with the

length; and as it requires the expenditure of energy to send a current over a resistance, obviously a high resistance means a large amount of energy lost in the transmission. By increasing the cross-section of the feeder, this resistance can be kept low; but the cost of the feeder would then be prohibitive. By

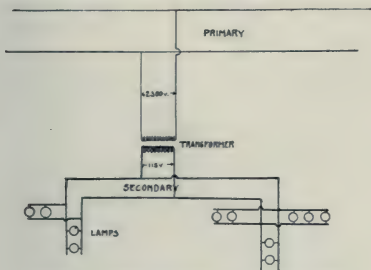


FIG. 14. CONNECTIONS OF A. C. SYSTEM WITH STATIC TRANSFORMERS.

means of the alternating-current system with static transformers, connected as shown in Fig. 14, energy can be transmitted at a much higher voltage from the station. The higher the voltage of transmission, the smaller will be the current (amperes) for a given energy (watts); therefore, with the high-voltage system, a given energy can be transmitted over a much smaller wire than would be required for that same energy at a low voltage. In the transformers placed at or near the point where the current is to be used, the pressure is "stepped down" to the voltage of the lamps on the circuit.

The regulation—that is, the steadiness and constancy—of the voltage of these alternating-current lines, was very much poorer than that of the direct-current system. This was largely due to the effects of self-induction, which is ever present with alternating currents. The early incandescent lamp used on the direct-current 110-volt systems was rather delicate, and had only a short life when burned on a circuit in which the pressure fluctuated very much. Consequently it could not economically be used on the existing alternating-current lines. A 50-volt lamp could be made far more stable, and, largely because of this, the secondaries of the early transformers were wound for 50 volts. The primaries were

wound for use on 1,000-volt circuits—which was then considered as high as desirable, because of the difficulties of insulating the line, the transformers, and other apparatus on which this voltage was applied. Rapid advance, however, was made in the art of insulating, and soon this primary pressure was doubled. Most of the city A. C. distributing systems now have a primary pressure of about 2,300 volts. It is interesting to note that the insulators used on the early European high-tension lines were constructed with a trough along the edge on the inner side, which was filled with oil in order to prevent current leaking over the surface of the insulator to the pin and thus to ground, by way of the cross-arm and pole, on wet days.

One of the larger of the early stations for the generation and distribution of alternating current was built in St. Louis, Mo., in 1889. The system adopted was single-phase, 1,200 volts, 60 cycles*, with a three-wire Edison system for the secondaries. These secondaries were tied together at street crossings, forming

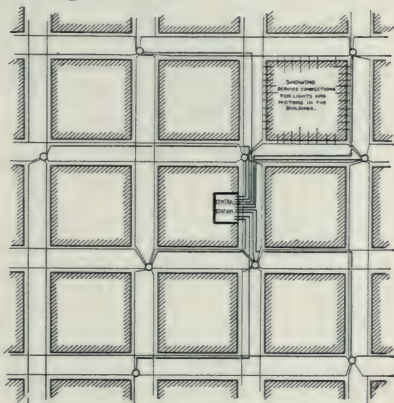


FIG. 15. NETWORK OF MAINS OF EDISON SYSTEM.

a complete network similar to that described for the direct-current system and shown in Fig. 15. In this case the feeders of the D. C. system were replaced by the high-tension A. C. feeders and trans-

* A current which alternates 120 times per second has 60 double alternations or "cycles" per second.

formers, the latter being treated as part of the feeders. Pressure wires were connected to the secondaries of the transformers, and were run back to the station voltmeters to be used by the switchboard operator in regulating.

An interesting alternating-current line was built between San Bernardino and Pomona, California, in 1891. Here a transmission pressure of 10,000 volts was used, obtained by means of connecting the 500-volt primaries of twenty transformers in series. Thus each transformer had to have insulation for a working pressure of only 500 volts, which was comparatively easy to produce.

In 1891 the celebrated three-phase transmission line from Lauffen to Frank-

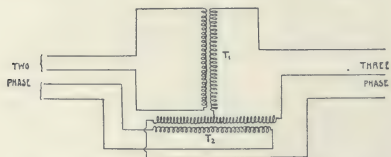


FIG. 16. CONNECTIONS FOR STEP-UP TRANSFORMATION OF 2-PHASE CURRENTS.

fort, in Germany, was operated. Originally this was intended for transmitting energy generated by water power at Lauffen, to the city of Heilbron, six miles away; but it was first used in the now famous transmission to Frankfurt, a distance of 110 miles, at the time of the Frankfurt Exhibition. The dynamo, built at the Oerlikon Works in Switzerland, was star-connected, and generated a star pressure of about 50 volts.

In a three-phase star-connected generator, the armature windings consist of three branches which are connected together at one end to a common point. These branches are so placed on the armature core that the wave of the alternating pressure is set up in one coil a little later than is the wave of pressure set up in the coil immediately ahead of it, and a little sooner than the wave in the coil immediately back of it. These three pressures then follow each other in regular succession, the phase difference (the time between similar values of the different waves) being equal to one-

third period.* The wires leading from the other ends of the three armature coils are called the "phase" wires, while the one connecting to their common join is the "neutral" wire. The pressure between a phase wire and the neutral is called the "star" pressure, while that between any two phase wires is the "delta" pressure. This latter is 1.732 times as great as the star pressure. For greater safety in operation—principally to prevent abnormal rises in pressure between a phase wire and earth—the neutral wire is thoroughly "grounded" by being connected to a plate embedded down in the moist earth.

The 50 volts' pressure generated at Lauffen was "stepped up" in transformers to 8,000 volts, delta, at which pressure the current was transmitted.

Development of Water Powers

After the success of polyphase transmission was thus established, a great impetus was given to the development of water powers, and the following years found this system adopted by many companies. One of the first of these in America was built at Telluride, Colorado, in 1892. The original pressure used here was 3,000 volts, three-phase, straight from the generator. As a result of an extended series of experiments made on this line in 1896, much valuable data was obtained regarding high-tension transmission; and to-day there are many such systems, some operated at a pressure as high as 40,000 volts, which is the pressure now used at Telluride, while a few others are going still higher. The limit to-day seems to be about 60,000 volts, but even this may be increased as the art advances.

The Sacramento-Folsom line, in California, built in 1895, originally transmitted 1,000 H. P. at 11,000 volts, three-phase. The generators were wound to give a pressure of 800 volts, and this was raised in transformers to 11,000 volts.

The Mechanicsville, N. Y., and the Snoqualmie Falls, Wash., plants are the most important three-phase transmission systems built in 1898. In the former, a

* A "period" is the time, in fractions of a second, for one complete cycle of the alternating wave—that is, for one double alternation; or, in other words, a period is the time taken by the coil in passing one pair of poles of the field.

transmission pressure of 12,000 volts, 38 cycles, was adopted; while in the latter, the generated pressure of 1,000 volts, 60 cycles, was stepped up to 25,000 volts.

Many of the polyphase stations built in the early nineties were equipped with two-phase generators. The two-phase currents were then stepped up and transformed to three-phase currents by means of a scheme of connections devised by

being about twenty miles from the station. When this station was first operated, in 1896, the transmission pressure was 11,000 volts. Since that day many high-tension transmissions have sprung into existence; and the increase in voltage is keeping step with the improvement in insulators, as already noted. An interior view of Power House No. 1 at Niagara Falls is shown in Fig. 17.

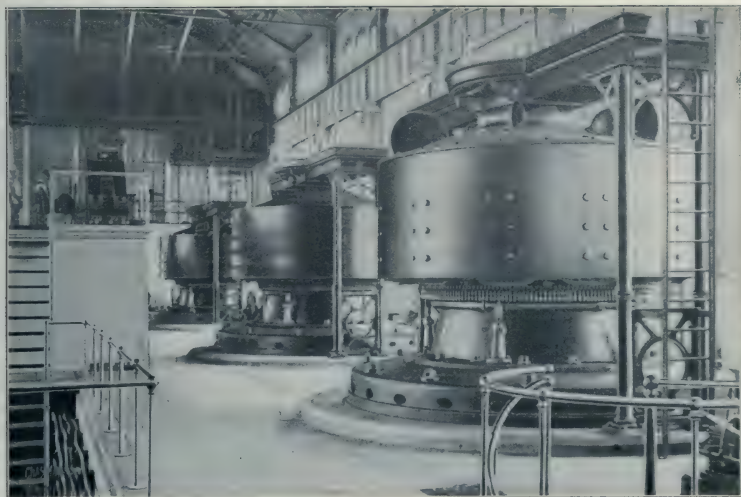


FIG. 17. WESTINGHOUSE 2-PHASE 2,200-VOLT 20-CYCLE TURBO-ALTERNATORS AT NIAGARA FALLS. POWER HOUSE NO. 1.

Mr. Charles F. Scott. This connection is shown in Fig. 16. In this diagram, T_1 and T_2 are two transformers, the primaries of which have the same number of turns and are connected to the two phases of the two-phase circuit. The secondary of T_1 has only .866 times the turns of the secondary of T_2 . By connecting one end of the secondary of T_1 to the middle of the secondary of T_2 , as shown, three-phase currents of equal pressures on each phase are obtained from these secondaries.

The best known example of this is the system at Niagara Falls, N. Y., where 25-cycle two-phase currents, generated at 2,200 volts, are transformed to three-phase currents at 22,000 volts, at which pressure the energy is transmitted to Tonawanda and to Buffalo, the latter

Function of the Storage Battery

While these important developments in cross-country transmission were under way, the engineers of the urban stations also had new problems to solve. The convenience and other desirable features of the use of electric light and power were now being widely appreciated, especially when the cost of the lamps was reduced, and electric motors also were being used more liberally, in sizes from one-fourth horse-power to 300 H. P. and larger. This meant a big increase in the load on the station, as well as in the size of the district to be served. How to meet this increase economically, required an intelligent study of the problems of current distribution. As already noted, the distance over which it is economical to transmit current at a low volt-

age is limited; and, when the area to be served exceeds this limit, recourse must be had to more stations or to a higher distribution pressure. A study of the load curve of an average central station in a large city (Fig. 18) shows that the feeders are carrying their heavy current

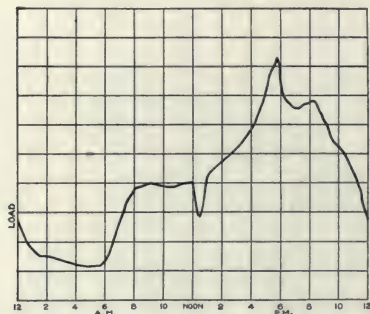


FIG. 18. TYPICAL LOAD CURVE OF CITY CENTRAL STATION.

for only a short time each day. During all the remainder of the day, then, the current in these feeders is comparatively small; also, much of the generating capacity of the station is idle, representing just so much investment inactive and earning no returns. If now, during the period of light load, a current, additional

to the regular load, can be sent over these feeders, and if this current can be stored in some way in a location within but near to the economical limit, so that it can be used at the period of heavy load, this storage substation will in turn become a point of distribution from which current can be sent out as far again as the economical limit. Here is where the storage battery filled the want. In 1894 we find storage-battery substations installed in Boston and New York, and soon thereafter companies in other cities adopted them. In Boston a number of battery substations were installed in the nearer outlying districts, all of them being connected with one another and with the steam station. The batteries are charged during the hours of light load by means of boosters, which form part of the substation equipment. Their usefulness, however, is not by any means limited to outlying districts. As an auxiliary to a generating station, it is considered good practice from the standpoint of economy to install a storage battery if the peak of the load does not exceed two and one-half hours. As a safeguard against interruption of service, and as a help in maintaining a uniform pressure on the system, they have been found almost invaluable.

(To be Concluded)



Mechanical Appliances in Modern Shipbuilding

Modern Devices that are Working a Revolution in the Shipbuilding Industry

By WALDON FAWCETT

IN THE COURSE of his testimony at the recent Congressional hearing relative to the condition of American shipping and shipbuilding, Mr. Cramp, probably the best known shipbuilder in the United States, made the statement that in this industry the advantage conferred by the superiority of the American workman is a thing of the

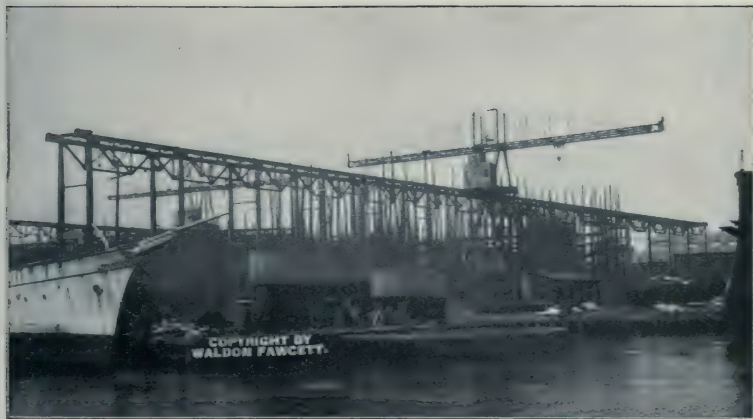
past. His explanation of this surprising statement was, that in this age speed and economy in shipbuilding are secured largely by the employment of the wonderful time-saving and labor-saving machinery introduced during the past few years, and that these products of Yankee ingenuity are being installed in foreign shipyards just as rapidly as the manu-

facturers can turn them out. Since these highly perfected automatic machines can be operated by any workman of average intelligence—by the poorly paid labor of Europe quite as well as by the high-priced American artisan—it is claimed that vessel construction all over the world will ere long be on one basis.

Steam and Electric Cranes

Of all the classes of mechanical appliances which are serving as factors in inducing the new status of steel shipbuilding, unquestionably the most important

the shipyard, is placed a high trestle upon a track, on top of which is mounted one of the cranes. The horizontal boom of the crane is high enough above the shipways to pass over the highest point of the ships being built, while the arms of the cantilever project over the full width of the ship on each side of the trestle. The cantilever of the crane is equipped with a trolley and hoist block, whereby the load can be hoisted from the ground and traversed from one end of the cantilever to the other. Thus, inasmuch as the crane travels up and down the trestle, the en-



MONSTER CANTILEVER CRANE AT CRAMP SHIPYARD, PHILADELPHIA, PA.

is that made up of the various kinds of cranes. Chief among these are the steam and electrically operated balanced cantilever cranes—one of the American inventions which has of late been most extensively adopted in the shipyards of the Old World. These giant burden-bearers, unquestionably the most perfect machines yet devised for handling material about ships in course of construction, embody new features in crane construction which allow the long spans and high speeds for which they are designed and equipped.

All the cranes of this type in use either in the United States or abroad are the invention of Mr. Alexander Brown, the well-known engineer, and all have the same plan of operation. Between each pair of shipways or building berths in

tire length and width of the two ships are covered, and materials may be handled and delivered to any part of the ships under construction. The trolley will attain any speed desired on the tramway, while the crane is capable of traveling along the track at a speed of 750 feet per minute.

One pair of engines, or an electric motor controlled by a single operator; drives all functions of one of these large cranes. The engines or motor and the machinery are located in the pier, and there is no dead weight carried either on the bridge or on the trolley. This allows the lightest form of bridge construction and very quick movement of trolley, and, especially, allows the trolley to be started, run at full speed, or stopped instantly. The cantilever cranes are equipped with

an automatic counterweight running on a track located on the bridge, above the hoisting-trolley tracks, and connected by ropes to the trolley so that whatever position the hoisting-trolley may occupy on one arm of the crane, the counterweight



GREAT FLOATING DERRICK "ATLAS," AT THE CRAMP SHIPYARD, PHILADELPHIA, PA.

at all times automatically keeps a similar position on the opposite arm.

Probably the best exemplification of the possibilities of these adjuncts of twentieth century shipbuilding is afforded at the Cramp plant at Philadelphia, where there are several of these cranes, all driven by electricity. Each crane is mounted on a steel trestle of special design and construction, about 600 feet long, and of sufficient height to bring the under side of the crane-girder 105 feet above the ground. One of these cranes, which may be considered as representative of its class, is 102 feet long from end to end of girders, with 190 feet effective travel of trolley. It will lift 30,000 pounds at 60 feet either side of the center, and 9,000 pounds at either end of bridge. A single electric motor operates all functions of the crane at the following speeds:

Hoisting a full load of 30,000 pounds—125 feet per minute.

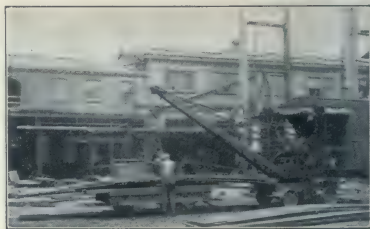
Trolley across cantilever—400 to 800 feet per minute.

Entire crane along trestle, on track of 20-foot gauge—400 to 700 feet per minute, depending on load and wind-pressure. The minimum of 400 feet is with full load and against a wind pressure of 30 miles per hour.

Recently this crane placed in position on shipboard, a battleship sternpost weighing eighteen tons, and, with the assistance of but a few men, conveyed it from the cars at the opposite end of the yard, an operation never accomplished under the old plan in less than two or three days nor without a large force of workmen engaged.

Derricks

Ranking with the cantilever cranes for marvelous achievement are the monster derricks to be found at several American shipyards. The best example is afforded by the "Atlas" at the Cramp yard—the largest and most powerful floating derrick in the world. The pontoon of the structure is 73 feet in length, 62 feet in width, and 13 feet deep. When carrying the maximum load of 125 tons at the boom end, and with water ballast aft sufficient to bring her to an even keel, the "Atlas" has a freeboard of 16 inches and a displacement of 1,563 tons. The cone has a diameter of 40 feet at the base; the length of boom from the axis is 58½ feet; and the boom swings 36 feet clear of the pontoon. The height from deck to masthead is 116 feet; and from deck to boom, 65 feet. The maximum hoisting height is 50 feet. The pontoon is of iron, while the boom, mast,



A LOCOMOTIVE CRANE.

and all lifting and traversing gear are of steel. The up-to-date shipyard also has a full equipment—there are twenty in the Cramp yard alone—of locomotive cranes, which are mounted upon box cars traveling on standard-gauge tracks, and

which handle material under all imaginable circumstances where the loads do not exceed several tons.

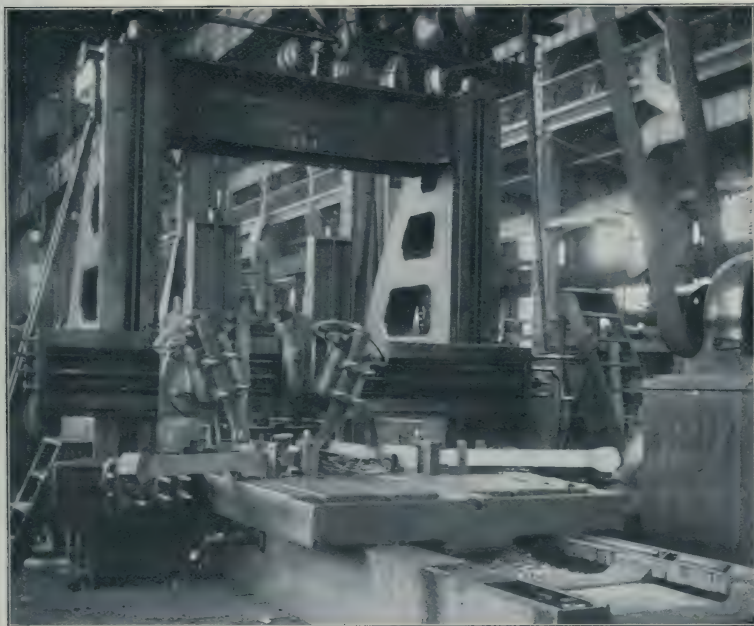
Machine Tools

Powerful machine tools constitute another of the utilities which are contributing largely to the advance of American shipbuilding. A review of the facilities in some of the larger plants discloses the following: A hydraulic man-

34 feet between the centers and has a swing of 125 inches.

Pneumatic Devices

American shipbuilders, who were the originators in introducing pneumatic machinery in shipyards, are yet well in advance in the utilization of this form of apparatus. Indeed, within little more than half a decade, there has been developed in American shipyards a system



LARGE PLANER, ELECTRICALLY OPERATED.

hole punching machine, which is accounted the heaviest in the United States, and which, with a pressure of 1,500 pounds, punches a manhole 18 by 27 inches in size from plates $\frac{3}{4}$ inch thick; 32-foot bending rolls, which are the largest in the world; some of the heaviest cutting shears ever made, with maximum dimension of cut of four inches; 36-, 60-, and 84-inch planers; a wall planer measuring 22 feet plane by 22 feet slot, which has no parallel in the world; and a 125-inch shafting lathe, which will take

of power riveting which surpasses anything previously attained anywhere in the world. At first an attempt was made to use pneumatic compression riveters similar to those in use in many bridge shops; but it was soon demonstrated that their great weight for the large gaps necessary in shipbuilding made it impracticable to handle them with either facility or economy in the case of ships on the stocks.

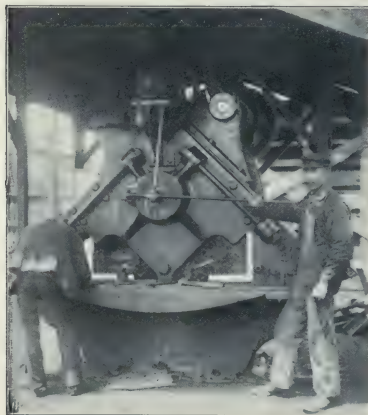
The shipbuilders, however, knew from experience, of the value for chipping and

calking of the pneumatic hammer, consisting of a piston rapidly reciprocating inside of a cylinder, and striking the end of a chisel; and this apparatus was gradually adapted to the driving of rivets.



PNEUMATIC HAMMER IN OPERATION.

Now it is possible to drive every rivet in a ship with machines which are very light, short enough to go between the frames of the vessel, and of sufficiently small diameter to render them thoroughly portable. Even shell rivets are closed up with the greatest ease and facility.



IRON CORNER CUTTER.

The adoption of these power riveters came just at the most opportune time, for the increase in the size of ships of late years has involved the necessity for

plating so heavy that to draw it up requires rivets too large to be properly driven by hand. From an economical standpoint, the power riveters perform wonders. In deck and tank topwork, for instance, three men and a heater boy will drive from 800 to 1,000 rivets a day. Not only is the whole operation of driving a rivet completed much more quickly than by hand, but it is done so expeditiously that the rivet has not lost its heat ere completion, and consequently there is gained the benefit of the resulting contraction, which, as the rivet cools, draws everything together with firmness.



PNEUMATIC STEEL CUTTER IN OPERATION.

Shipbuilders in this country who have made a careful computation, figure out that machine riveting, adding the cost of air, repairs, etc., effects a saving of from one to two cents per rivet over piecework prices for hand riveting, the degree of economy depending upon the location in the ship, and averaging fully $1\frac{1}{4}$ cents. In the shipyards on the Great

Lakes, where pneumatic machinery of this class is used very extensively, the saving on an ordinary lake steamer of 4,000 tons is from \$4,000 to \$5,000. One machine will not infrequently drive 450 $\frac{7}{8}$ -inch rivets in a single day. At the regular hand-work rate, this would involve an outlay of \$15.75; whereas, with the machine, the cost is but \$5.50, including the wages of operatives and the cost of power.

Another class of pneumatic tools in use in shipyards consists of chipping, calking, and bending hammers, machines which range in weight from 7 to 11 pounds and which have a stroke of from one to four inches at speeds varying from 3,400 to 2,200 strokes per minute according to size. These hammers require 20 feet of free air per minute, and work at a pressure of from 70 to 80 pounds. The heavy chipping hammers weigh fifteen pounds, and attain a speed of 1,200 blows per minute for the 7-inch stroke. Most powerful of all the hammers is what is known as the "9-inch stroke riveting hammer," which has a speed of 900 strokes per minute. A pneumatic holder-on is in use in many shipyards, instead of the ordinary bar, for holding up the head of the rivet. It can readily be put

the limit for reaming and tapping being $1\frac{1}{2}$ inches. Such a drill requires about 25 feet of free air per minute to operate it at 80 pounds' pressure. Side-light cutters, deck-boring machines, and other pneumatic appliances also have place in the equipment of the modern shipyard. Some yards have in use at one time as many as 400 portable riveters, calkers, drills, etc. Power for the machines is



PNEUMATIC DRILL IN OPERATION.

furnished in most instances by a $2\frac{1}{2}$ -inch main; and an air pressure of at least 110 pounds is carried, supplied by an air compressor capable of delivering, say, 5,000 cubic feet of air per minute.

Machine and Brass Shops

The machine and brass shops and other under-cover portions of modern American shipyards have within the past few years shown vast improvement in equipment and arrangement. An ideal structure of this kind—the newest shop at the Cramp plant—is 335 by 143 feet, and of steel-skeleton framework construction. The floor load in the second story is 400 pounds per square foot, while the third floor is designed for a load of 350 pounds per square foot. The structure has a main central traveling-crane runway, served by two 50-ton electric cranes, with a span of about 57 feet, center to center of supporting girders. On either side of the main central portion are galleries 42 feet wide. The floor space in the lower story of both wings is served by electric cranes of from 10 to 30 tons' capacity.



PNEUMATIC RIVETER IN OPERATION.

into position, and presses the rivet against the sheet with a force of 1,200 pounds when 100 pounds of air pressure is used.

Several styles of pneumatic air drills are in use in shipyards; but a machine that is typical in all respects weighs 35 pounds, and will drill in cast iron up to 2 inches, or in steel up to $1\frac{5}{8}$ inches,

Some idea of the magnitude of a present-day shipyard of the first class, may be gained from the fact that the Cramp yard at Philadelphia represents an expenditure of more than \$7,000,000; and the great shipyard at Newport News, Va., on Hampton Roads, involved an even greater outlay. In the laying out of all our big shipbuilding plants, heavy expenditure has been made to secure convenience, speed, and economy in the conduct of operations—a continuous, unretarded movement forward of the material from the time it enters the yard in raw state until it is ready to leave as part of a completed ship. To this end, buildings have been grouped—at the Cramp plant, joiner, pattern, machine, and erecting shops are combined within the shelter of one immense structure 1,164 feet in length—and all material is conveyed by short hauls.

Use of Electric Power

In conclusion, a word should be said regarding the extent to which electrical energy is displacing steam power in the operations of the more important shipyards. Not only are almost all the cranes, large and small, electrically operated, but almost every one of the big machine tools is impelled by an individual motor, thus insuring a great saving, since the power need be turned on only when actually needed. The electrical outfit which at the Newport News yard furnishes power for running all the machines in the shops and also supplies current for the 2,500 incandescent and 150 arc lights in the plant, consists of three 600-K. W. generators driven by three compound engines; two 125-K. W. generators driven by one horizontal-compound engine; and two 75-K. W. generators driven by simple engines.



The Machinery of Modern Warfare

No. II. Ingenious Devices that Increase the Efficiency of Peacemakers

By RUTLEDGE RUTHERFORD

THIS IS AN AGE of new machines of war. In the last issue of *THE TECHNICAL WORLD* were described several of the new weapons and methods of destruction that were making their appearance in the Japanese-Russian war. But these are not all. The fever to invent devices that will destroy life and property in the quickest and most wholesale manner, is catching; and nations seem to vie with one another in their efforts to produce the most deadly weapons. Indications are that the next decade will witness radical changes in the features and methods of manufacture of all war materials.

The new era of fighting devices through which we are now passing, seems to have had its birth in the recent South African war. That stubborn struggle not only tested the courage and en-

durance of the English, but incited the Englishman's wits, awakened his latent mechanical genius, and brought forth new inventions that have surprised the world. In Thibet the British are now testing for the first time several marvelous new contrivances that had their inception in ideas originating in South Africa.

The Hyposcope

The very newest of these contrivances, and one that has a most promising future, is a new rifle-sight that enables a soldier to shoot at the enemy while the marksman hides behind a rock or tree or otherwise completely obscures himself. This is regarded as war's masterpiece of protective mechanism, and is causing a great amount of comment in Europe. The sight is called the "Hyposcope." The pictures of the rifle with the new arrange-

ment, herewith presented, are the first that have been printed in any American periodical.

means of a screw placed several inches below the rifle back sight so that the needful elevation can be obtained without



SOLDIER SIGHTING RIFLE BEHIND PARAPET, BY MEANS OF HYPOSCOPE.

An ingenious arrangement of mirrors is the basis of this new and remarkable invention. The mirrors are contained in a light, strong metallic case, which is easily attached to the rifle and which enables the marksman to take aim from behind an embankment or other obstacle, without exposing himself. When first tested a short time ago in Thibet, the hyposcope fully demonstrated all that was ever claimed for it. The Thibetans, falling before the fire of the unseen foe, were completely nonplussed and fled in dismay, declaring that the very rocks and hills rained death on them when they went forth to fight the British. The result has been to create an uncontrollable superstition among the Llama's forces that they are the objects of Divine enmity and that the unseen powers of Providence are fighting against them.

The hyposcope, it is claimed, can be used at any range shown on the back sight of any rifle. Shooting may be as accurately continued without an ordinary back sight as with one—which is equivalent to an additional back sight, should that on the rifle be rendered useless. A trustworthy telescope is thus also added. The elevation of the hyposcope can be accurately and immediately effected by

moving the rifle from the rest or exposing any part of the marksman to the enemy.



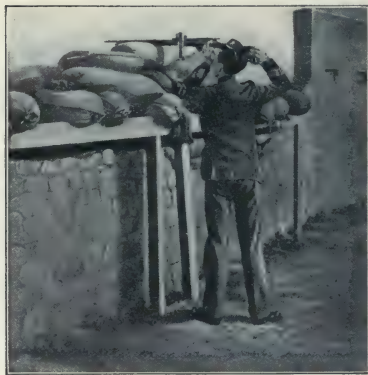
THE HYPOSCOPE.

A Gun Sighting Attachment Consisting of Encased Mirrors. It enables the soldier to aim without exposing himself.

One of the most remarkable of the attachments is a lateral wind gauge. A table of wind allowance is in full view of the marksman. The tube of the instru-

ment is square instead of round, with a field of view of six degrees. The tilt of the rifle from its vertical axis is visible in the sighting focus.

The accompanying illustrations show the manner of using the device and the method of its attachment to the ordinary rifle. A modified form of the instrument



CLOSE-RANGE SIGHTING FROM BEHIND BREASTWORK.

is known as the "ordnance" hyposcope, and is attached to field pieces or automatic guns.

The Pom-Pom

Another English device that has demonstrated its destructive qualities is the pom-pom. This was also a product of the Boer war. A gun having the power of a cannon, which can be carried about on the backs of horses, up mountain paths, across streams, over narrow bridges, through thickets and marshes, and, in fact, everywhere a horse can go, it has in real action proved itself to be one of the most valuable military additions of a decade. Lieutenant-Colonel Simpson of the British Army, who, in the fighting around Ladysmith, first employed pom-poms, says:

"One of the revelations of the South African war has been the pom-pom. Shortly after the relief of Ladysmith, I was ordered to exchange the guns of one section of No. 4 Battery for four pom-poms, with a view to its conversion into two sections under special pom-pom officers. They did good work until they were taken up at the end of the war. It struck me at the time how useful a section of jointed pom-poms in pack transport attached to a brigade division of mountain artillery might

be in Indian frontier warfare; and I made certain representations to the authorities, which, I am glad to see, have borne fruit, orders having been given by the Indian Government for the construction of a section of jointed pom-poms for experimental trial in India. These guns will probably be handed over to the infantry, and treated rather as a 'glorified Maxim' than as a piece of artillery; I hope otherwise."

The pom-pom is a gun of the field type, slightly modified to enable the barrel and water-jacket to be detached from the breech casing. The carriage is constructed so as to be readily taken to pieces, and consists of crosshead, elevating bracket, elevating gear, trail, axle, and wheels. The crosshead, which carries the gun, is attached to an elevating bracket by means of holding-down lugs, and can easily be detached from the mounting by turning the same 80 degrees. The elevating bracket is support-



RUSSIAN BATTERY OVERWHELMED IN BROKEN ICE.

ed in the front lugs of the trail in such a manner that it is removed from the axle at the same time as the trail. The rear part of the elevating bracket forms a segment which serves as a support for the traversing clamp fixed between the lugs of the breech casing. By means of this clamp the gun can be locked in any position between the traversing limits.

The trail is telescopic, and consists of two outer and two inner parallel steel tubes, held together by transoms. The inner tubes are drawn out to their full length when the gun is in firing position. At the front end of the outer tubes are two fork-shaped brackets, by means of which the trail is secured to the axle, and supports are afforded for the elevating bracket. The gun is fed from an ammunition tray carried on the right side of the crosshead. The pack saddlery is similar to that of the 2.95-inch gun, with the cradles adapted for the loads.

chine guns," which have recently been brought into additional prominence because of their adaptation to cavalry use. The term "machine gun" is self-explanatory. The gun is a machine devised to economize time and labor in the work of destroying an enemy; it is a contrivance that makes one machine perform the work of many men, thus reducing the risk, and increasing the amount of destruction. It is the champion time-saver in war's work of dealing death. Within the range of its deadly, sweeping fire, a whole regiment can be mowed down in



HOW THE COSSACK INTRODUCES HIMSELF TO A MANCHURIAN VILLAGE.

For transportation the parts of the gun and equipment are divided into different loads, so that the horses may carry them conveniently and expeditiously. What is known as the first load consists of the barrel and water-jacket, shield, etc.; and the weight is 295 pounds. The breech casing and attachments form the second load, and weigh 278 pounds. The axle forms another load; and the wheels, trail, and ammunition are all carried by separate horses, the different loads being designated by different numbers. The gun can be brought into action in $2\frac{1}{4}$ minutes.

Machine Guns

In describing formidable guns of the present day, it would be amiss not to mention those of the class known as "ma-

an insignificantly short time, while one man turns the crank that pumps the streams of bullets from its multi-celled barrel.

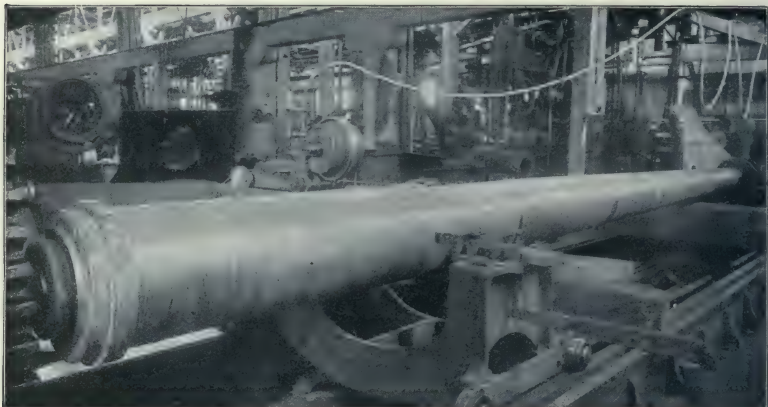
The Gatling

The "Gatling," the first successful machine gun, owes its origin to America, the nation that gave to the world the iron-clad war vessel, the monitor, the turret battleship, and numerous others of the most formidable weapons of the day. Like these weapons, the Gatling gun came out of that titanic struggle when Americans warred with Americans, when American strength and ingenuity strained its every tendon in the strife against American strength and ingenuity.

The Gatling gun is a machine gun of the mitrailleuse order. It was invented

by Dr. R. J. Gatling, of Indiana, in 1861. It has from five to ten barrels, each barrel having a corresponding lock. Al-

breech is closed when the discharge occurs; while through the agency of the backward motion, the empty cartridge-



ENTIRE LENGTH OF NEW BROWN WIRE-TUBE GUN IN SHOPS AT READING, PA.

though the barrels and locks revolve together, the locks have a forward and



JAPANESE COOLIES BRINGING HOSPITAL STORES ASHORE.

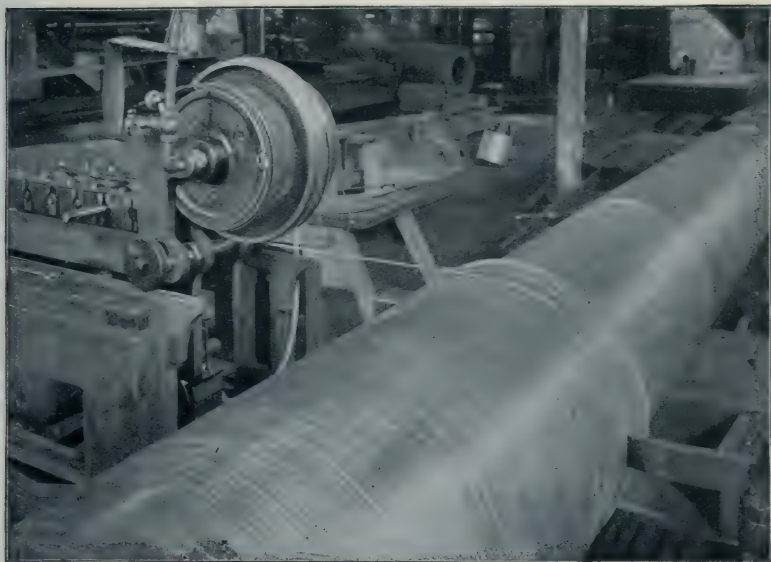
backward action. By means of the forward motion, the cartridges are placed in the chambers of the barrels, and the

cases are extracted. The gun is fed by feed cases, which are made to fit in a hopper communicating with the chambers. Continuous firing can be carried on by the ten-barrel gun at the rate of 1,000 shots a minute, as one case is replaced by another as fast as it is emptied. The five-barrel gun weighs 100 pounds. It is mounted on a tripod, and can be fired at the rate of 800 shots per minute. The bore of each barrel extends from end to end; and the breech is chambered to receive a flanged "center-fire" metallic-case cartridge. The breech ends of all the barrels are screwed into a disc, called the "rear barrel-plate," which is fastened to the central shaft; the muzzles pass through another disc, called the "front barrel-plate," on the same shaft. A hollow metal cylinder is fastened upon an extension of the central shaft, and is called the "carrier-block," behind which the shaft carries another cylinder, because each lock is acted on by a spiral spring operating the hammer by which the charge is fired. The shaft, the group of barrels, the carrier-block, and the lock cylinder, being all connected, revolve together; this revolution is effected by a toothed wheel, which is fastened to

the shaft, and which is worked by an endless screw on a small axle placed at right angles to the shaft and furnished outside with a hand crank. When the lock cylinder revolves, it carries the locks around with it, and gives them a longitudinal, reciprocal motion by their rear ends slid-

of Santiago the Gatlings again repulsed sorties and night attacks.

All the important powers of the world now have machine guns. Among the more noted of them, besides the Gatling gun, are the Maxim, the Vickers-Maxim, the Hotchkiss, the Skoda, the Gardner,



WINDING TWENTY MILES OF STEEL WIRE INTO NEW BROWN GUN.

ing along a groove in the inclined surface of the stationary spiral cam, so that the several locks in succession are forwarded toward their respective barrels. The Gatling gun is elevated and lowered like an ordinary field gun. The effects of its fire are invariably demoralizing.

Gatling guns deserve the credit for the American victory in the charge at San Juan Hill—a fact that is not generally known. There, in spite of the absence of gunners, of spare parts, and of tools, Lieutenant Parker, by the aid of four Gatlings, seized the position of San Juan in 8½ minutes—a position that was regarded as impregnable. He repulsed two counter-attacks by the Spaniards, silenced a five-inch gun at a distance of 2,000 yards, by firing on its cannoneers with a single machine gun. During the siege

the Nordenfeldt, the Maxim-Nordenfeldt, the Martigny, and the Pratt-Whitney. All are copied after the Gatling, and are operated on the same principle. China and Japan are well supplied with Maxims and Hotchkiss guns. The regular Chinese troops are armed with Gatlings.

The Wire-Tube Gun

The very newest American war invention is the Brown wire-tube gun. The first one of these has just been built at Reading, Pa. It is a 6-inch coast-defense gun, and it is claimed that it will carry 30 miles. A projectile fired from it has a velocity of 3,500 feet a second. An improved type that is now being proposed is expected to carry much farther. This weapon, some believe, will cause the American gun to become more famous than the Krupp.

The Brown wire-tube is 26 feet long, and weighs 20,000 pounds. It is built to withstand a pressure of 100,000 pounds at the breech and 50,000 pounds at the muzzle. This muzzle strength is greater than the breech strength of the guns now in use by the American Army and Navy. The manufacturer of the new weapon states:

"The possibilities of guns of this kind are marvelous. It is estimated, for instance, that a 10-inch gun will throw a shell nearly 60 miles, and that a gun of this pattern of larger size will throw a projectile 100 miles. All this is in remarkable contrast with guns made years ago, and especially those used before the Civil War, when they were often made of a single piece of cast iron. While wire-wound guns

advantage over all other guns because of its enormous powers and its tensile strength and elasticity.

Military Track Bicycle

Germany has attained distinction of late through the manufacture of some very meritorious devices. One contrivance of German origin that is of special interest, is an arrangement known as a "military track bicycle," whereby an ordinary bicycle may be used on track rails, enabling the soldier to carry his piece handily and fire it when he desires without dismounting. It is planned to use this unique contrivance in the Russian army in guarding the Trans-Siberian railroad. In the frame of a light guiding carriage of Mannesmann tubing, one or two bicycles are placed and easily connected, the whole forming a solid car, as it were. The apparatus can be taken apart in a few seconds, and assembled according to need. It can be driven by one or two persons. The inventor is Lieutenant von Trutzschler of the Kaiser Alexander regiment, who thinks that the contrivance will serve to lighten the difficulty of railway patrol service in all wars of the future.

A New Type of Submarine

From Japan comes the news that Captain Oda, inventor of the types of submarine mines used by the Japanese, one of which destroyed the Russian flagship *Petropavlovsk*, has invented a new engine—something between a torpedo and a mine—charged with nitro-glycerine in enormous quantities and driven by an oil motor. When Russia's Baltic fleet reaches Eastern waters, if it ever shall, these engines will be used against it; and positions are already prepared in Formosa and the Loo-Choo islands with that object. There will be no crew on board these vessels, which apparently will be steered by some application of wireless electricity. Full precautions will be taken to prevent any accidents to neutrals; and, as explosion takes place after a certain lapse of time, there will be no risk of live mines remaining adrift on the high seas.



A TRACK BICYCLE.

By this device an ordinary bicycle can be used on railroad tracks.

are not altogether new, the wire-tube differs from all that have ever before been used in many important respects."

The wire-tube is built of rolled steel sheets, upon which are wound layers of polished steel wire. The lining tube is of forged steel. More than 20 miles of square steel wire is wound over the steel sheets. Then a trunnion jacket of forged steel is shrunk over the wire. At the breech of the gun there are 21 layers of wire and at the muzzle seven layers. The tension in winding is about 128,000 pounds to the square inch. The wire-tube is the invention of J. Hamilton Brown. It is believed to have a great

Great Technical Schools

Stevens Institute of Technology, Hoboken, N. J.

By FRANKLIN DeR. FURMAN, M. E.

Associate Professor of Mechanical Drawing and Designing

STEVENS INSTITUTE OF TECHNOLOGY, the first technical school for instruction in the subject of Mechanical Engineering, was established in 1871 through the munificence of Mr. Edwin A. Stevens, who was the surviving member of a family trio that will ever rank among the greatest of the world's pioneer engineers.

A Family of Engineers

A word, in passing, may not be amiss to indicate what these three men (Col. John Stevens and his two sons, Robert L., and Edwin A.) accomplished, and how substantial a foundation they laid for the prestige that is attached to the name of Stevens. Before the close of the eighteenth century Col. John Stevens was engaged in steamboat construction, and, in the year 1804—three years before Fulton's *Clermont* was started as a commercial enterprise—operated a steam propeller boat on the Hudson River. His early plans, however, were many years in advance of the mechanic's art; and the propeller, now so universally employed, did not come into successful use for a long time after. In 1807 he had under construction the paddle-wheel vessel *Phoenix* in his own shops at Hoboken; but Fulton in that year imported an engine built in England by Watt, and placed it in the *Clermont*, thus being the first to make practical application of side-wheel boats. By this act Fulton secured exclusive rights to the waters of New York State for steam navigation. Thus prohibited from operating his steamboats in home waters, Colonel Stevens sent the *Phoenix* around to Philadelphia in 1809, under the supervision of his son, Robert L. Stevens. This was the first steam vessel to brave the fury of old ocean. "For the resolute, there is ever the open sea."

While the construction of the Erie Canal was under discussion by the legis-

lators of New York State in 1812, Col. John Stevens earnestly petitioned them to construct a railroad instead of the canal, and ventured to predict that an average speed of thirty miles per hour could be attained, and that sixty miles might be. Twenty years later he built, as a private venture, on his own estate in Hoboken, the first locomotive and railroad track in America. This was soon followed by the construction of the Camden & Amboy Railroad, now a part of the Pennsylvania System.

During the war with England in 1813, Robert L. Stevens invented the elongated shell to be fired from cannon. In 1814 Col. John Stevens projected the circular iron fort to be revolved by steam; and under his direction his son Edwin carried on experiments to determine the results of firing cannon against iron plates, as a result of which the Stevens brothers conceived the plan of applying iron plating to war vessels. In 1841 they entered into negotiations with the United States for the first armor-plated battleship.

Such were some of the inventions and enterprises of the Stevens family of engineers. But this is not all, for in the development of their comprehensive plans in those early days, it was necessary to invent many objects of detail which of themselves are of no small importance. Thus, when Col. John Stevens invented the tubular boiler, and applied the principle of the screw to propeller blades in order to carry on his experiments in navigation, there was no patent protection in this country; and so, on his petition, the Patent Law of April 10, 1790, was founded. In order to carry on the work of railroad development, Robert L. Stevens invented, in 1830, the T-rail and the railroad spike which are now in universal use for track construction on steam roads. It was R. L. Stevens who used steam expansively, in 1815; who

first burned anthracite coal in a cupola furnace; and who, with his brother Edwin A. Stevens, first successfully applied the artificial blast to the boiler furnace. Not only these, but many other inventions could be credited to the Stevenses, but it

strong faculty, first opened the doors of Stevens Institute for the reception of students. During the first year, 21 young men were in attendance—2 Juniors, 3 Sophomores, and 16 Freshmen. The first graduate of Stevens Institute was J.



MAIN BUILDING, STEVENS INSTITUTE OF TECHNOLOGY, HOBOKEN, NEW JERSEY.

is not the purpose of this article to enter into any further detail of their engineering work. This digression is made, first, to show that the establishment of the Stevens Institute of Technology as a school of Mechanical Engineering was a fitting outgrowth of the busy and successful lives of three pioneer engineers; and secondly, to record a matter of public interest not generally known.

Founding of the Institute

Edwin A. Stevens died in 1868, leaving in his will a block of land adjoining the family estate at Castle Point, Hoboken, N. J.; \$150,000 for the erection of a building; and \$500,000 as an endowment fund for an "institution of learning."

On the third Monday in September of the year 1871, the Trustees, having erected a suitable building and assembled a

Augustus Henderson, M. E., the sole member of the first class of 1873, and the first person to receive legally the degree of Mechanical Engineer.

Dr. Henry Morton was early engaged as President by the Trustees; and he aided largely in laying down the plans for the new institution, and in selecting the first faculty. This was a most important task, for, while there were technical schools in this country and abroad, they were devoted mostly to Civil Engineering. There was no course anywhere in Mechanical Engineering after which to pattern. Under these circumstances the outline on which the work of the new institution was laid down by the Trustees and President Morton was most remarkable, for nothing that they prescribed has, in these thirty-three years, been found useless in a thorough course of in-

struction. Their plans have grown; and new subjects, notably Electrical Engineering, have arisen; but all have found a place within the scope of the original scheme, published in full in the Announcement issued in 1871.

The details necessary to the fulfillment of the general outline were left to the judgment of an able faculty, of whom but three now remain; but these, and

ROBERT H. THURSTON, C. E., Professor of Mechanical Engineering.

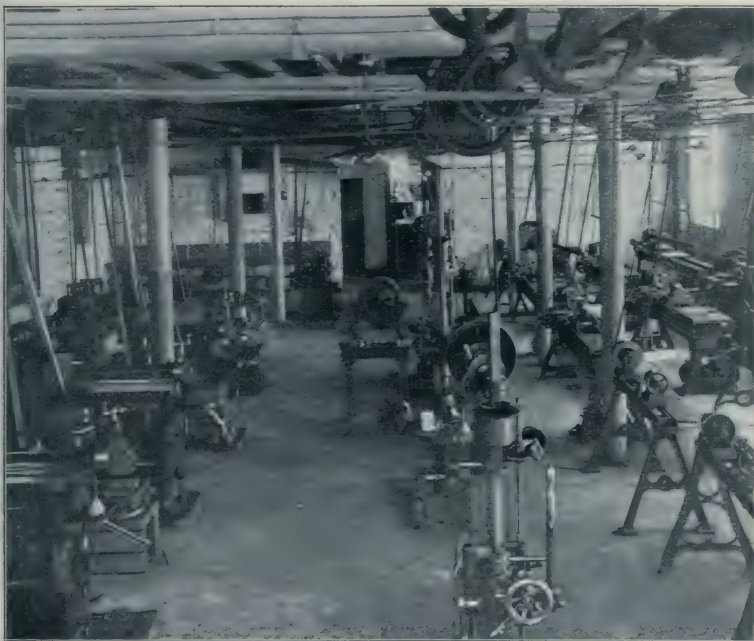
DE VOLSON WOOD, C. E., Professor of Mathematics.*

CHARLES W. MACCORD, A. M., Professor of Mechanical Drawing.

ALBERT R. LEEDS, A. M., Professor of Chemistry.

CHARLES F. KROEHL, A. M., Professor of Languages.

REV. EDWARD WALL, A. M., Professor of Belles-Lettres.



NEW MACHINE SHOP.

those who have gone beyond, builded so well that nowhere can progeny be found better fitted than their own; and so the sons of Stevens have, in the main, been chosen to carry on their work. The names of the men who thus originated and carried on the early development of the course are of men who achieved, principally through their work while at the Stevens Institute of Technology, high places in their respective lines. These men were:

HENRY MORTON, PH. D., President.

ALFRED M. MAYER, PH. D., Professor of Physics.

Starting with this faculty and with these subjects, the Institute has grown and broadened, always increasing its efficiency as the new facts resulting from discovery and investigation developed, until now its work might be briefly outlined as follows, taking the enumeration in the order of the departments mentioned above:

*Lieut-Col. H. A. Hascall was originally engaged as Professor of Mathematics; but, on account of ill-health, he taught only a few months. At the end of the first year he was succeeded by Professor Wood, who was the first to arrange the detail plan for this course.

The Various Departments

In the Department of Physics, the first two years are given to instruction in the several branches of Physics by means of experimental lectures, recitations, and laboratory exercises. In the Department of Experimental Engineering, the students are then carried forward in this subject during the last two years.

The Department of Mechanical Engineering, so comprehensive at the start, soon grew to bounds beyond efficient con-

In the Department of Experimental Engineering, the students, having been drilled in the principles underlying engineering practice, are required to perform, or to witness, experiments illustrating these principles. The exercises which each student has to make, include the taking of data and making calculations therefrom: they now number over 50, and cover the various types and forms of the steam engine, the gas engine, boilers, pumps, compressors, blowers,

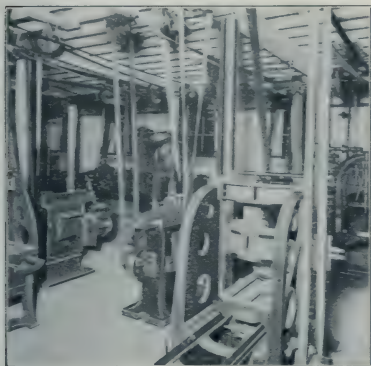


WOODWORKING SHOP.

trol under one head, so that to-day there are in its place the Departments of Engineering Practice and Experimental Engineering, each carrying on subdivided branches of work. In the former department, the students are carried through a very thorough course of instruction in the general principles controlling the action and generation of heat, and the power and economy of prime movers. They are also instructed in the general principles governing the design and operation of various other machines and mechanisms, such as pumping engines, air compressors, and refrigerating machines.

etc.; they also include a number of experiments in hydraulics, and in numerous essential mechanical devices such as safety-valves, dynamometers, belting, gear trains, indicators, gauges, thermometers, feed-water heaters, and water heaters, and investigation of such processes as radiation, condensation, friction, flow of steam, determination of properties of woods and metals, analysis of flue gases, refrigeration, etc. This work is all carried on in the light and commodious quarters provided by Mr. Andrew Carnegie in 1902, in the Carnegie Laboratory of Engineering, which adjoins the main Institute building.

Allied with the Department of Engineering Practice is the course in Shop Work, in which the students are carried through a carefully graduated set of exercises in Carpentry, Blacksmithing, Pattern-Making, Foundry-Practice, and Steam-Fitting.



A CORNER IN THE NEW MACHINE SHOP.

The Department of Mathematics provides a thorough training in the principles of Mathematics, with various and numerous applications to practical engineering problems. Special attention is given in the first two years to the mathematical consideration of elementary Mechanics, and in the last two years to more advanced work in the same line. This work is made to coordinate with the work in the Department of Physics during the first two years, and with the several Engineering Departments during the last two years. It is held that in confining the work of this department as far as possible to practical problems, the students are rendered more efficient, and they gain greater confidence in the use of Mathematics.

The Department of Mechanical Drawing has enlarged upon its original scope, and is now known as the Department of Mechanical Drawing and Designing, which better describes the work conducted at the present day. The students are first taught the efficient use of drawing instruments. The course then carries them through the theoretical and practical requirements of the modern drafting room. Special attention is given

to Descriptive Geometry; Analysis of Mechanical Movements; Valves, Valve Diagrams, and Valve Gears; practical Machine Design; and practice in Steel Construction Work. It is recognized that in this department the instruction must, to a maximum degree, combine theory and practice; so the instructors aim to keep in touch with modern shop practice, and to give to the students that which will be the most useful when they enter upon their professional careers. The work of this department is carefully coordinated with that of the several Engineering Departments.

In the Department of Chemistry the students are grounded in the fundamental principles of the subject by means of experimental lectures and recitations supplemented with a thorough laboratory course in Engineering Chemistry.

The Department of Languages provides courses in French (or Spanish) and German. These languages have a practical value to the engineer in his professional work, and also afford that kind of mental discipline and culture which mathematical and physical science, if followed exclusively, would fail to supply.



FORGE ROOM.

The title of the original Department of Belles-Lettres is now changed to the Department of English and Logic. Its purpose has ever been to furnish the means of cultivating the use of appropriate and accurate language in speaking and writing, of becoming acquainted with the principles of Logic, and of increasing by

the study of Literature the knowledge of human life and character. This department follows the students into the other departments, drawing upon them for themes for essays; and finally it passes on the composition of all graduating theses, which must conform to the standard of the department. No effort is spared to impress upon the students that their success as engineers will depend

gaged in erecting gas plants in nearly every quarter of the globe, Mr. Humphreys recognized the great value of the business instinct in the technical college graduate. He had employed a great many Stevens men in his own work; and, positive of the enhanced value of a technical degree with a fundamental knowledge of business principles behind it, he labored several years to give the subject



ELECTRICAL INSTRUMENT LABORATORY.

largely upon their work in this department.

In addition to the expansion of the seven original departments as outlined above, two entirely new ones have been added, the necessity for them having developed since the course was founded. The first of these two to be introduced was the Department of Applied Electricity, in 1893; and the other, the Department of Business Engineering, in 1903.

The Department of Business Engineering was the outgrowth of the efforts of Mr. Alexander C. Humphreys (now President Humphreys), of the Class of '81. Successful in his professional work, chiefly with the upbuilding of the United Gas Improvement Company, and later in the firm of Humphreys & Glasgow, en-

a footing in the already crowded course at the Institute. In 1897, at the request of President Morton, he arranged a course of lectures by prominent bankers and business men. This was followed by a brief course of instruction; but it was not a requisite and completely established part of the curriculum until 1903, when he had become President of Stevens Institute. He then took personal charge of the work, and created the Department of Business Engineering. In this department the effort is made, first, to bring the students to appreciate that engineers must practice their profession in conformity with commercial conditions and limitations. Then, by means of lectures and recitations, instruction is given in Accounting, Depreciation, Shop Cost,

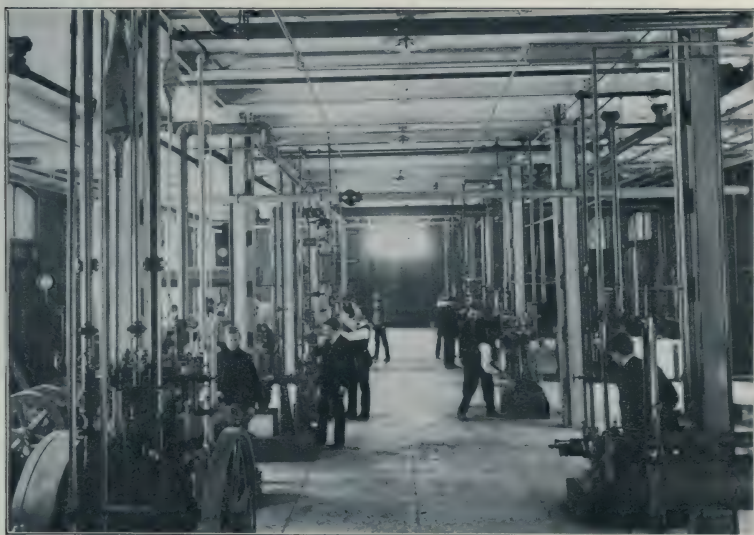
Analysis of Data, Law of Contracts, and business methods in general. This work is confined to the Senior year.

Only One Degree?

The course of study in the Department of Electrical Engineering, which now takes the place of the Department of Applied Electricity established over twenty years ago, has kept pace with the rapid advancement in that branch of the engineering profession. Such is the efficiency of the course in the Department of Electrical Engineering at Stevens at the present day, that, with some rearrangement of roster, the degree of Electrical Engineer could be given fairly; and the question whether it should be, or not, has recently received serious consideration.

give only the degree of Mechanical Engineer, combining with it the fundamentals and essentials of Electrical Engineering.

The young mechanical engineer will unquestionably have more opportunities if versed in the fundamentals of Electrical Engineering; and the young man who would seek a specialized training for the degree of Electrical Engineer, would certainly have a great advantage if he were first well trained for the profession of Mechanical Engineering. Substantiation of the reasons for continuing to give the single degree of M. E., especially for those who wish to follow Electrical Engineering, could be found—were substantiation necessary—in the



MAIN FLOOR, CARNEGIE LABORATORY OF ENGINEERING.

To establish another degree would be to depart from the tradition which has always been associated with Stevens, and that is, that she concentrates her whole energy on one degree, and that one in Mechanical Engineering.

The sentiment of prominent Alumni of Stevens—men prominent in electrical lines especially—seems to be almost unanimously against conferring two separate degrees, and in favor of continuing to

records of the Stevens graduates of former years who are now occupying positions at the very top of the electrical profession, and those of more recent years who have entered the works of large electrical manufacturing establishments, and who report uniformly that they are enabled to hold their own with the E. E. graduates of other technical colleges which specialize during the last one or two years of their course.

Every student at Stevens is required to take the complete course of study, with no options or specializing. This has been the distinguishing feature from the beginning of the Institute, setting Stevens apart from all other technical institutions, and giving a strength to her degree of Mechanical Engineer that is not surpassed.

Stevens graduates have risen everywhere to high positions in nearly every branch of engineering work, as may be seen by examining the list of positions of the Alumni of Stevens, published annually in the Institute Catalogue. It is there shown that more than one-third of the graduates have risen to or above the responsible position of Superintendent, many being Managers or Presidents. Among the remaining two-thirds, are largely the Alumni of the past eight years, who comprise fifty per cent of the total number of living graduates; of the latter, who are yet very young men, many



ONE OF THE DRAFTING ROOMS, RECENTLY ENLARGED.

are doing responsible work although regularly rated as assistants, etc. As an example of the various lines of work in which the Stevens graduate is successfully engaged, we find in the above-mentioned list, officers of railroads, superintendents of iron and steel mills, electric light engineers, electric railway engineers, manufacturers of electrical apparatus, gas engineers, specialists in steam, marine engineers, designers and builders of various kinds of engines, hydraulic engineers, bridge builders, sugar manufacturers, flour manufacturers, refrigerating engineers, oil refiners, locomotive builders, copper refiners, manu-

facturers of instruments, superintendents of paper mills, manufacturers of textile machinery, mining engineers, etc. This list of occupations is quoted from a recent address by President Alexander C. Humphreys, M. E., Sc. D., LL. D., who also states in this connection, that "the same college course furnished each of these men a solid foundation upon which to build the superstructure required for his selected vocation."

President Morton, who had successfully developed the work of Stevens Institute from the beginning, and who had made this his life work, was called to his eternal rest in May, 1902. His labors for the advancement of Stevens were taken up in September of the same year by Pres. Alex. C. Humphreys, who had been his close personal friend for a number of years. President Humphreys was graduated at Stevens with the Class of '81. He had always taken the greatest interest in the affairs of the Institute; and when the question of electing a successor to President Morton came up, the Trustees were unanimously petitioned by the Faculty and Alumni of the Institute to extend a call to Mr. Humphreys. This the Trustees promptly did without a dissenting voice.

Endowment and Equipment

The original endowment of Stevens Institute, as already mentioned, was \$500,000. The principal sources of revenue received since the establishment of the Institute, have been from the late President Morton, who, at various critical periods, gave sums ranging from \$2,500 to \$50,000, and aggregating \$145,000. Not all of this remains as an endowment fund, for much that President Morton gave was applied to meeting the growing demands for accommodation. For example, he gave \$10,500 toward fitting up a workshop in 1881, and \$15,000 for the building of a new boiler room in 1901. In 1899, Mr. Andrew Carnegie donated \$65,000 for a new Laboratory of Engineering; and, upon its completion in 1902, he gave \$100,000, and a year later an additional \$125,000, making a total of \$225,000 as an endowment fund for the building. In 1897, Mrs. Martha B. Stevens, widow of the found-

er, gave a plot of ground, with house—valued at \$30,000; and in 1903, Col. Edwin A. Stevens and Mr. Robert L. Stevens, both sons of the founder, gave a valuable tract of land close to the Institute grounds.

The equipment for carrying on the course of study, including the provision of new and rearranged rooms and the installation of new apparatus, has un-

In the forge room, ten new down-draught forges, operated by a motor-driven blower and exhaustor, have been installed. New accommodations have been made for the exercises in moulding, and an extension built to accommodate a new half-ton Collicau cupola. The extension also contains a core oven, and accommodations for exercises in core-making. Also, a new room has been



DYNAMO ROOM, ELECTRICAL LABORATORY, LOOKING EAST.

dergone considerable change in the past two years. The drafting rooms have been enlarged to an uninterrupted floor space of 60 by 40 feet each, with ample window space for light. They are also equipped with individual adjustable electric light pendants, permitting each student to place the lamp, when required, so as to avoid shadows. The workshops have been entirely overhauled during the past year, the metal- and wood-working rooms each being large (60 by 40 feet) and well lighted, and well equipped, the former with lathes and planers, drill presses and milling machines, shapers, etc., and the latter with wood lathes, a wood planer, circular and band saws, etc., all of the latest types.

equipped for the exercises in steam-fitting and vise work.

After the student has finished the course in Shop Work, he takes up exercises in handling and testing boilers, engines of various kinds, machinery, and apparatus likely to be met with in professional life. These exercises are conducted in the thoroughly equipped new Carnegie Laboratory of Engineering.

Electrical Laboratory work is conducted in two large rooms, each recently equipped with much up-to-date electrical apparatus. The "Instrument" Laboratory is equipped with a large variety of measuring instruments and standards.

The Chemical Laboratories include two entire floors in the west wing of the

main building, and are especially equipped for carrying on work in Engineering Chemistry. Plans are now nearly complete for a new Laboratory of Chemistry, to be named the Morton Memorial Laboratory of Chemistry, in memory of the late President Henry Morton.

A large and attractive auditorium, seating 1,700 people, was constructed in the central wing of the main building last summer.

In conducting the course of study at Stevens, advantage is taken of the proximity to New York City, and to the great industrial and manufacturing centers near by. Classes, or sections of classes, may be taken conveniently on short half-day or day trips by the instructors, when such visits fit specially well with any particular class-room topic.

The enrollment of students at the Institute during the current college year is 346. The Faculty has steadily grown from the seven original members to twenty-four at the present time.

In connection with the Institute, and on the same grounds, there is a prepara-

tory school in which there are 309 students in attendance. Boys who can pass satisfactory examination in geography, elements of English grammar, and arithmetic, may enter the lowest class in the preparatory school and take up a thorough course not only for Stevens Institute but for any University or College. Complete English, classical, and scientific courses are provided. The close relations of the Stevens Preparatory School with the Stevens Institute, give the former peculiar advantages in carrying out its courses of study.

The Institute building and grounds are situated on rising land, one block from the river front, and overlooking lower New York City and New York Bay down to the Narrows. A large athletic field, situated about eight minutes' walk from the Institute, is available to the students. A plot of land, now part of the private grounds of Castle Point, two minutes' walk from the main building, was given to the Institute recently by Col. E. A. and Robert L. Stevens, for dormitory purposes.



Ignition in the Automobile Engine

A Comparison of the Different Methods Employed in Starting

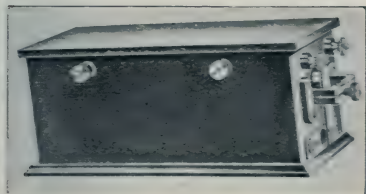
OF THE TWO GENERAL METHODS OF IGNITION—the jump spark and the make and break—an observation of the different motors shows that either method can be successfully used with either the high or low speed, single or multi-cylinder motor. The jump spark method possesses the advantage of mechanical simplicity and the disadvantage of electrical complication, while the make and break possesses electrical simplicity and mechanical complication. Either

method can be successfully used with any of the regular apparatus for furnishing the electric current—that is, the battery, dynamo, or magneto, or combination of dynamo or magneto and battery, providing the complete apparatus is consistently designed.

It is noticed that the jump spark with battery is meeting with probably the greater favor by American automobile manufacturers, while the European builders are using the make and break spark more extensively with the alter-

nating-current magneto. The alternating-current magneto is also used with the jump spark on a number of foreign cars.

Batteries possess the advantage over other forms of current generators, that their maximum strength can be used for starting the engine, but the disadvantage, that, after the engine is running, they



INDUCTION COIL FOR IGNITION PURPOSES.

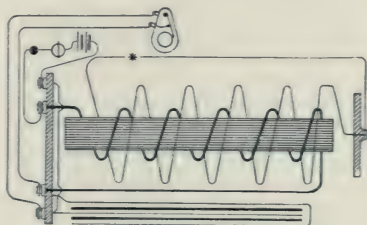
grow weaker rapidly, until they are exhausted. Some kinds can be recharged to advantage; others must be replaced with a new battery when exhausted. The first cost of batteries is low, and their care is fairly well understood by the average operator. The fact that it is impossible to determine in any practicable way just when a battery will become exhausted, and the cost of maintenance, are probably its most objectionable features.

The dry battery, which is used most extensively, is reliable and cleanly, but of short life, making it expensive to maintain. It will regain part of its original strength, if allowed to rest after being exhausted; but, when once exhausted, a new battery should be considered a necessity of the near future.

The storage battery, in connection with the dynamo or direct-current magneto, forms an ignition system which is almost ideal theoretically, but oftentimes impracticable. The storage battery is of great strength and is reliable until exhausted, providing proper care is taken of it; but unless it is given more attention than is generally given such a small part of an automobile, it will prove a failure. For instance, if it be charged above a certain maximum rate, it will not receive a normal charge, and will therefore become exhausted earlier than it would naturally do. If it be discharged above a certain maximum rate, the battery will not only fall short on its present charge, but on

all subsequent ones; and the time of its ultimate complete destruction is hastened by the excessive discharge rate. If the battery has been allowed to discharge after the voltage has reached a certain minimum indicated by the makers of the battery, generally about one and eight-tenths volts per cell, sulphating and its consequent troubles result. Owing to the nature of automobile work, this last abuse is probably responsible for the bad reputation that storage batteries have acquired with those experienced with them. The storage battery should be both charged and discharged through ammeters; and the discharge should be watched with a voltmeter, not to mention tests with hydrometer for specific gravity, etc. It is not practicable to observe these precautions for ignition purposes.

The dynamo system for ignition, with the speed-governing pulley, is theoretically a very fine ignition system; and, if operated by one familiar with caring for electrical apparatus, it is really a very satisfactory method. This system, however, possesses two very great disadvantages: first, the dynamo generates a direct current of low voltage, necessitating close care and attention to be given the dynamo; second, the dynamo must run at a constant speed, necessitating the use of a speed-governing device, which, for



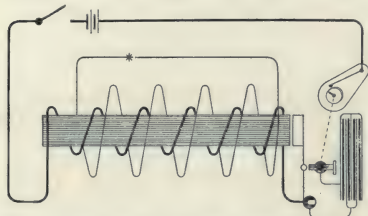
JUMP SPARK COIL.

the service required, has not proven altogether reliable. The dynamo system will sometimes work perfectly for a very long time, and then fail at a time most disastrous to its operator, without any apparent reason for its stubbornness.

The combination of a comparatively high-voltage direct-current magneto with a reliable battery for starting purposes, forms a very satisfactory ignition system,

even in unskilled hands; but it possesses the disadvantage that it is sometimes impossible to find room for such a system. Then, too, the batteries must be attended to occasionally, and the apparatus should be overhauled each season.

The writer is decidedly prejudiced in favor of ignition by means of the alternating-current magneto. The alternating-current magneto, from an electrical standpoint, is the simplest electrical generator made. For ignition purposes, it al-

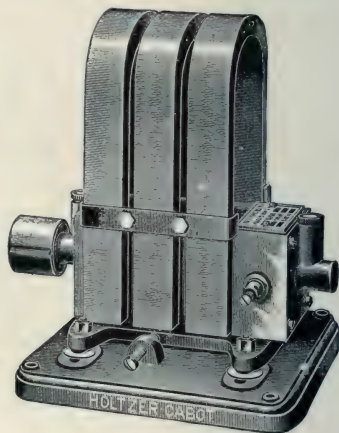


JUMP SPARK COIL, WITH VIBRATOR.

lows of the most simple, positive installation in use. When used with the jump spark, a coil without vibrator is used with it, and but one coil for single or multi-cylinder engines. When used with the make and break spark, no coil is used. Owing to the very efficient designs of these magnetos, they will furnish a satisfactory spark at any speed between 30 and 3,000 revolutions per minute. An alternating-current magneto, not like the direct-current machine, generates its current only at certain points in the revolution of the armature. It is evident, then, that a magneto of this type must be driven by the engine through some positive mechanism, such as gears, chain, or pitman rod, and that the magneto and engine must be so connected mechanically that the spark will be generated at the required point of the engine's revolution. Owing to the ability of this magneto to generate a large spark at so low a speed as 30 r. p. m., engines can be readily started from it with the magneto driven at the same speed as that of the engine, at which speed it is usually driven. The magnetos now in use generate two sparks

for every revolution of the armature. The above, it is obvious, would be the proper speed for four-cylinder engines. If eight cylinders are to be fired from one magneto, the magnetos are run twice as fast as the engine shaft.

The magneto alternator, when used with either make and break or jump spark, permits of the ordinary spark timing, except that the timing mechanism for the jump spark is very greatly simplified. Since the spark is generated at certain points in the revolution of the armature of the magneto, it is necessary, in order to change the time, only to change the relation of the armature to the engine crank; and this is accomplished by a simple construction made a part of the magneto. Probably the



VERTICAL MAGNETO.

greatest advantage in the magneto alternator system of ignition, lies in its simple and positive construction. The magneto, not having either commutator or collector rings and brushes, conducts its current through the simple bronze bearings of the machine, which are oiled in the usual manner. There are no adjustments, and oil and dirt cannot damage the apparatus.—FRANK REMY in *Automobile Review*.



The Forgery of Antiques

How European Dealers Take Advantage of the Collector

By GUSTAVUS MURRAY

THE CRAZE for collecting anything old has swept Europe clean of antiques. The moment the American tourist makes an inquiry for antiques, the modern Italian looks upon him as a bird to be picked. He knows there are no antiques left. He remembers his father selling at a good price their carved chest, brassware, a madonna, and even the household pot-

in Florence and in Carrara, and seen 'age' given to marble by a newly discovered process which in twelve hours will give to a statue 500 times its true value. One sculptor, in whose studio fifty men were hard at work making antiques, in-



FORGED RIBBON-BACKED CHIPPENDALE CHAIR.

tery. At first the Italians told the tourists there were no antiques left; but, finding the truth of no avail, and being an obliging people, they invented a new industry—the counterfeiting of antiques—which has to-day become almost a fine art.

An English gentleman of many years' residence in Italy, says: "I have stood in more than one sculptor's studio, both



BOWL WITH COVER.
Imitation of Imari Porcelain.

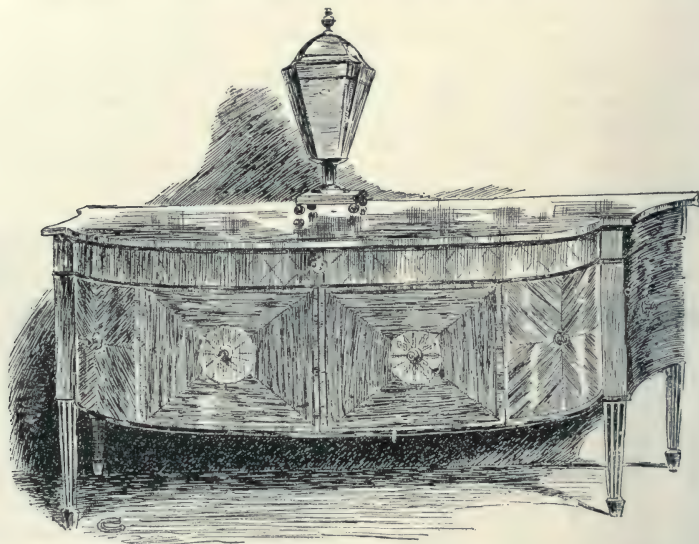
formed me that the greater part of his output was shipped to an agent in New York, who judiciously distributed it to dealers all over America." So clever is this mode of giving age, that the combination of acids applied is absorbed by the marble and turns it yellow right through, so that even experts can be deceived by those ingenious imitations of Michael Angelo, Donatello, and other celebrated sculptors.

At Athens there is a factory busy all the year round turning out by the score "ancient" Tanagra terra-cottas. One of these imitations will be sold for fifteen hundred dollars when fifteen dollars is every penny it is worth.

When old silver became the fashionable craze, the little stores on the Ponte Vecchio contained many genuine chalices, goblets, sugar basins, and the like

To-day these stores are well stocked with so-called ancient silverware, but not a single piece is genuine. There are factories in Holland that turn out old silverware by the hundred pieces. They take

In spite of all the care taken by collectors, a gentleman employed in a European museum gave his opinion that twenty-five per cent of all the antiques in private collections were forgeries. To



AN IMITATION SHERATON SIDEBOARD.

a genuine piece—say a fine old goblet—and produce exact copies. By a chemical process they give them an appearance of age that would deceive the eyes of an expert. For years there has been an increasing demand by collectors for mediæval armor and arms. In a back street of a prosperous Italian city is the workshop of a man who is a genius at manufacturing every conceivable kind of armor, from breastplates to gauntlets, from halberds to swords and daggers, all stamped with the monograms of some famous Spanish or Italian armorer.

The steel is treated with acids; the bronze hilts of swords are dipped in some kind of solution to give the appearance of age and use; then the pieces are placed in boxes of damp earth to induce rust; and in a week or two they are ready to be sold to the dealers at so much a dozen.

such an extent is this counterfeiting carried on that after a Russian nobleman had spent twenty-five thousand dollars in



FORGED CANDELABRA OF THE 17TH CENTURY.

forming a collection of cameos, so many when carefully examined proved to be forgeries, that, despairing of separating

the false from the true, he sold the entire collection for what it would bring.

In Manchester, England, a large number of men are employed in making old furniture. The large majority of the supposedly genuine Sheraton, Chippendale, and Happlewhite sold in London, each with a certified pedigree that runs back to the middle of the eighteenth century, are probably not more than three months from the factory. A dealer described the making of a sixteenth century chair in these words: "You make the chair to pattern, soak it in a certain fluid, then shoot a few rounds of small shot into it, to give it a worm-eaten appearance, and there you are!"

Grecian terra-cottas, Louis Seize, Queen Anne furniture, Tanagra statuettes, Egyptian pottery, ancient brasses, pictures, armor, arms—in fact, you have

only to say what particular antique you want, and the London, Paris, or Italian dealer will in a week's time secure it and supply gratis an unimpeachable history, sworn to by the descendant of six generations.

Sacred scarabs, little Egyptian charms, are manufactured by a Connecticut firm. They are carved and chipped by machinery, colored in bulk, made to simulate age, and shipped in casks to the Moslem dealers in Cairo. The Arabian guides are the chief buyers, many of them being adepts at "salting" the sands at the base of the pyramids or about the sacred temples, where they artfully discover these scarabs before the very eyes of the Yankee tourist, and sell him, for an American dollar, an article manufactured at a cost of less than a cent, perhaps within a stone's throw of his own home.



The Worth of a Patent

AS SOON AS the average man obtains a patent upon any device, he considers that his fortune is made, and that he has only to let people know what he has done and where he lives to be overwhelmed with offers for it at his own price. The facts are that a patent is no more and no less than documentary evidence that the holder of it is entitled to its exclusive use. If he does not wish to use it, and will not sell it at a reasonable price, the inventor holds a piece of paper only, which deteriorates rapidly from the competition of other inventors in the same field. What is a reasonable price for an invention, depends wholly upon circumstances and conditions. If it relates to an article that will have only a moderate sale, a very moderate sum is all that can be expected, if, indeed, a manufacturer be found who desires to take the matter up.

Inventors, however, are often without experience or knowledge in regard to the business side of the question and the difficulties which attend the introduction and marketing of even a meritorious article. Before a patent can make returns to any one, much time and money must be put into it, and all this is to be recovered before the investor can recoup himself for his outlay, to say nothing of making money on the venture. The large sums said to be paid for patents that are not remarkable for novelty, being mere improvements upon existing machines or relating to some unimportant article, are mostly fiction. Inventors are apt to have an exaggerated idea of the value of their patents, and to think that they should receive for their patent what it may be worth after all the work required has been done and the demand has been created.

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- ☛ Occasionally a man who runs for an office wins in a walk.
- ☛ A brick manufacturer needs the earth in his business.
- ☛ Some society women have better clothes than manners.
- ☛ If a man makes no enemies, he has but few friends.
- ☛ Intellectuality is the cause of baldness. So says a baldheaded scientist.
- ☛ A thousand-dollar boy with a ten-thousand-dollar education is over-capitalized.
- ☛ Don't get gay. It is easier to keep the lid on than it is to put it back on again.
- ☛ The next time Russia wants a war loan, she might apply to the St. Louis hotel men.
- ☛ The trouble with many a young man is that he spends his fortune before he makes it.
- ☛ Sometimes a man loses his job because he doesn't know enough, and sometimes because he knows too much.
- ☛ People often make the excuse that they have bad memories, when the truth is, they are too slovenly to use their brains.
- ☛ One of the greatest mistakes that a man can make is to sit down at a desk and worry himself sick over business and then call it a day's work.

☛ A wise girl is known by the company she doesn't keep.

☛ Habit may be a man's best friend or his worst enemy.

☛ Expert testimony depends upon who employs the expert.

☛ Nearly all commuters imagine Hades is a suburb of Heaven.

☛ A gentleman is a man who agrees with you; a crank is one who doesn't.

☛ Love is a serious matter the first time a young man bumps into it.

☛ If the average girl doesn't play the harp in the next world any better than she plays the piano in this, there's going to be trouble.

☛ If people would only give as much thought to governing themselves as they do to the government of the nation, the welfare of all would be assured.



Our Commercial Advance

THE YEAR ENDING JUNE 30, 1904, marks the best all-round business year in the history of the United States. The exports of American manufactures were larger than in any preceding year, and the exports of domestic products exceeded those of any other country. This, in a single sentence, is the record of the year's commerce just announced by the Department of Commerce and Labor through the Bureau of Statistics.

The United Kingdom is, next to the United States, the world's largest exporter of domestic products, and, until within recent years, surpassed the United States in its total. During the past few years, however, the United States has rapidly gained upon and finally overtaken the United Kingdom in the race for supremacy as an exporter of domestic products.



The Electrifying Process

THE RECENT DELIVERY to the New York Central Railroad of several 85-ton electric locomotives capable of hauling heavy trains at the rate of 75 miles an hour, for use on the 44-mile run between Croton and the Grand Central station in New York City, is the

practical answer to the old-time objection that the electric system was too costly, and the perfection of the electric locomotive too remote, to constitute a practical commercial issue. Taken in conjunction with the proposed electric equipment of the leased South Shore line, which parallels the New York Central to Buffalo, and the proposed creation of a gigantic system of trolley transportation throughout the State by the absorption of all electric roads that interfere with local traffic, in order to make them feeders of the main line—an absorption already far advanced—this incident calls attention to one of the most significant developments of our industrial life today.

All over the more populous parts of this continent, the "electrifying" process has, during the past five or six years, been working a revolution in the relations of men to one another. First Ohio, then Indiana, then Illinois and Iowa, and now New York, have been paralleling their railroads with trolley lines. In the Middle States, perhaps, are found the largest contiguous reaches of fertile soil in the world, which not only yield rich crops at small cost of cultivation, but which are almost all underlain by coal or petroleum within easy reach; and nowhere are there fewer obstacles to line construction than on those prairies—either in the way of physical difficulties, or of indisposition to grant a right of way on the part of the intelligent farming communities who will be served. In all cases these lines have developed, almost from the start, a paying business which grows from year to year at a surprising rate; and—a feature even more remarkable—the traffic on the steam lines has also increased. The trolleys, running at brief intervals from point to point, and starting from the heart of the cities and towns, have simply created their own business and set people moving about who otherwise would have remained as inert as the proverbial snail.

As these electric lines become connected endwise in longer and longer stretches, flouting the railroads everywhere, it is not to be wondered at if the steam companies should wish to have them as feeders, rather than as competi-

tors, which, up to distances of 40 miles or so, they certainly are. Thus the absorption movement is bound to continue, and we may look for more and more consolidation until the time comes, prophesied by the late Jay Gould, when we shall be face to face with the problem whether the railways shall run the government, or the government shall have to run the railways. The issues are serious, but not beyond the power of the American public to work out an intelligent solution.



Need of a Parcel Post

IN GERMANY a package weighing four pounds may be sent by mail to any part of the country for a postage of four cents. To mail a similar package in the United States would cost 64 cents. A parcel may be mailed from England to Canada for three-quarters the postage it would cost to send the same parcel a dozen miles in this country.

One of our greatest public needs is a parcel post. *Education in Business*, in discussing the subject says: "The immense advantages of the parcel post system—to which any well-informed traveler will bear witness—are being denied us because of the power of the great private corporations, the Express Companies, in our legislative halls.



Amalgamated

"WHEN ROGUES fall out, the devil is to pay." But then, it almost seems, as Mr. Barnum once said, that the American people "like to be humbugged," and it is an admitted fact that substantial and meritorious enterprises will often "go begging" for the sinews of strength, while the wildest of wildcat schemes—provided only they hold out the promise of "easy money" and "big money"—have little difficulty in imposing themselves upon a confiding public.

Mr. Lawson's alleged "inside" history of the Amalgamated Copper deal, to which he was himself a party, is—if it be not to be taken with a grain of salt—merely one more eye-opener to the methods of stock manipulation which in recent

years have made serious inroads upon the hard-earned funds of small and sorrowful investors. It is a common thing for stocks, based on properties of relatively small or even of no value, to be offered to the public as safe and profitable investments, and to be sold at enormous profit for the promoters at the expense of the sanguine investor who is allured by the Midas touch of the "most honorable men" on the directorate. This method of getting other people's money is more respectable than asking them for it on a dark night at a pistol's point. It is also far safer, for it seems to be covered within the law. But does it not seem rather anomalous to send to jail a "bunco steerer" for selling a gilded brick to an unsophisticated rustic, while another who sells a fellow a finely engraved certificate, of exactly similar value, should be merely expected to give a small fraction of his gains to philanthropic purposes?

Neither business reaction, nor tight money, nor politics will explain the persistent stubbornness of the people in refusing to flock back to the stock market. They have seen the long list of receiverships with their unsavory revelations, reduced dividends, and unexplained slumps in stocks of other companies, and naturally look askance at all stocks with which the names of the manipulating "Napoleons" of finance, however exalted and pious, are associated. They suspect that the gambling is going on with loaded dice, and will invest only when they have a tip that the dice are loaded on their side. The whole business thus becomes immoral.

A greater man than Mr. Lawson once sang of the "damned lust for gold;" the "Story of Amalgamated" is the solo obligato of the financial chorus.

✽

A New Cure for Intemperance

AT THE OPTICIANS' CONVENTION held recently in Milwaukee, Wisconsin, Dr. Prentice of Chicago, in a paper read before the delegates, stated that in properly fitted eyeglasses lay a possible cure for alcoholism. This statement is based on observations to the ef-

fect that the craving for alcoholic stimulants is caused mainly by a derangement of the intimate and delicate relations of the optic nerve to the system.

Of course it is only natural to smile at such an idea, and whisper softly "crank." In view of the fact, however, that medical specialists often put eyeglasses on their patients to cure headaches and nervous dyspepsia, it would seem well to reserve our decision. An editorial discussing Dr. Prentice's paper, says: "If we once concede that a failure of the eyes to 'focus' properly upon an object produces a nervous irritation which in turn produces an abnormal appetite, and that the patient acquires the habit of trying to satisfy this appetite with alcoholic stimulants, is it unreasonable to assume that a correction of the ocular difficulty would restore natural conditions?"

We look forward with much interest to the discussion of Dr. Prentice's paper in the scientific journals.

✽

Wireless Telegraphy and Exploration

MARCONI, in discussing the progress of wireless telegraphy, calls attention to its value in exploration. It will not be necessary in the future for arctic explorers to die from starvation, because they are lost from civilization. By means of wireless telegraphy it will be very easy for an exploring party to keep in daily communication with their home people. Hereafter every arctic expedition, probably, will be equipped with a wireless telegraphic outfit. The explorer can tell his friends at just what point he stands. If he is in need of supplies he can direct how these shall be forwarded to him and of what they shall consist, and he can direct his rescuers how to reach him.

All that applies to the arctic explorer applies with equal truth to the explorer in the jungles in the interior of Africa and Australia. Had the wireless telegraph been invented in Dr. Livingstone's time, it would not have been necessary to send Henry M. Stanley to Lake Tanganyika to find him. He would have been able to wire for help when he first fell a victim to the jungle fever.

How to Make Electrotypes

By S. R. BOTTONE

THE ENTHUSIASTIC AMATEUR who has succeeded in producing some of the beautifully artistic work of which the lathe is capable, or who has in his possession a coin or medallion from which he requires to take a duplicate, will be pleased, and agreeably surprised, by the charming results that can be obtained by reproducing these in *copper*, by electro-deposition. The process is at once simple and inexpensive, and, by a little modification, can be used to give reproductions either precisely similar to the original, or ones in which the reliefs and depressions are reversed. As the latter, in ornamental turned work, are very effective, we shall describe the method of obtaining these first.

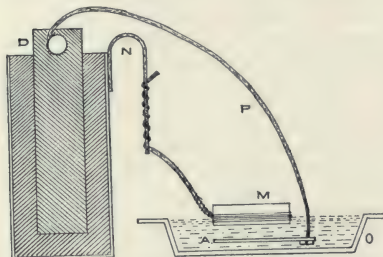
Reversed Duplicates

The operator will provide himself with two or three good "dry cells." A convenient size measures 6 in. by 2 in. He will also require a saturated solution of sulphate of copper (blue vitriol), which he can make by pouring one quart of boiling water on one pound of sulphate of copper, stirring frequently with a stick or glass rod until cold. The solution should be made up in a glazed earthen vessel. When quite cold, about one and a-half fluid ounces of oil of vitriol should be added to the blue fluid, in a fine stream, with constant stirring. The addition of the oil of vitriol will cause the solution to get hot. It must be allowed to cool, when it may be placed in a stoppered bottle, ready for use. Several discs of thin sheet copper (about 1-16 in. thick) of varying diameters, according to the size of the work to be reproduced, will also be needed; and to the edge of each of these (which are called "anodes") is to be attached a wire by drilling a little hole near the edge of the disc, and inserting therein one end of a 10-in. length of No. 16 copper wire, and

burring it over the plate by hammering. This makes good contact, without soldering, which is to be avoided. The next requisite is a rather deep, flat-bottomed, circular, well-glazed, earthenware dish. A soup-plate will answer very well, unless the objects to be copied are very large, in which case one of the square white earthen dishes used by photographers wherein to wash their prints may be used. Two or three yards of No. 18 or No. 20 bare copper wire will also be required for the purpose of connecting up the wooden ornamental turned work to the negative pole of the dry cell.

Being provided with the above necessities, the operator selects the turned work which he desires to reproduce in copper, and brushes over the worked surface with a paste made of good fine plumbago (black lead) and a little water. The brush made use of must not be so hard as to mark or in any wise deface the delicate tracery of the original; but, on the other hand, it must be sufficiently firm to enable the operator to get up a brilliant, metallic-looking surface like that of a well-polished stove. For convenience of future reference we shall call this blackleaded surface the "front" of the mould (technically termed the "cathode"). The purpose of performing this operation is to render the wood, which would not otherwise conduct electricity, conductive on this surface. It must be borne in mind that wherever the black lead has been applied, *there* will the copper be deposited. Hence to prevent waste of battery power, copper, and time, care must be taken not to carry the black-leading too far up the sides of the work. A little way up, it must reach, so as to enable good contact to be made with the wire, which will afterwards serve to connect the work to the negative pole of the dry cell. The best way to effect this is to take a strip of paper, and roll it tightly round the sides of the work, leaving about $\frac{1}{4}$ in. bare all round near the front

of the mould. Holding this tightly in the left hand, it will be easy to blacklead and polish the edge as well as the front without encroaching too far up the sides. When this has been satisfactorily effected, the paper strip, which served as a guard, can be removed. Now, taking a piece of the No. 18 or No. 20 bare copper, and gripping one end in the vice, he will wind it two or three times round the blackleaded edge of the work, so as to grip it firmly and make good electrical contact with the black lead under it. The extremities of this wire are brought together and twisted tightly, so that the coils may not loosen. The wire should now be cut off at a distance of about 10



D, Dry Cell; P, Wire to Positive Terminal; N, Wire to Negative Terminal; M, Mould or Cathode; A, Anode; O, Dish.

in. from the work, and bent upwards at right angles to the front of the mould. An anode is now selected, having a diameter as nearly as possible that of the front of the mould. (This wire, so far as it will be immersed in the copper sulphate solution, must be painted over with a little Brunswick black, otherwise it will be eaten through by the solution.) The other end of this wire must then be clamped under the terminal affixed to the carbon (or positive) pole of the dry cell, and then bent twice at right angles in such a manner that the anode can lie flat at the bottom of the dish, which must be placed near the dry cell. The dish should now be filled to a height of about 1 to 1 1/4 in. from the bottom, with the copper sulphate solution prepared as directed. The work to be copied is now attached, by its slinging wire, to the zinc (or negative) pole of the dry cell, and the wire

so bent that the front of the mould is immersed in the solution as far as the wire binding extends, or, say, for a depth of about 1/4 in. The work should lie perfectly horizontal, facing, but *not touching*, the anode, at a distance of about 3/4 in. to 1 in. from its surface. In immersing the mould, care must be taken to avoid air bubbles, and this can be done by letting down the front of the mould, somewhat tilted, so as to allow any air bubbles to escape; the wire can afterwards be straightened to cause it to lie horizontally. Great care must be taken that *good metallic contact* is made between the two wires and their respective dry-cell terminals; and also that no chance contact occurs, either between these two wires on the one hand, or between the mould and the anode on the other. After thus connecting up, the front of the mould should be allowed to remain in the solution for about fifteen minutes. It should then be examined in order to judge of the success of the work.

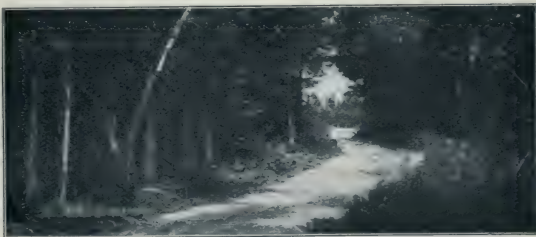
If the binding wire shows that it has received a rosy-pink deposit, beginning to extend to the edge and creeping round to the front of the mould, all is going well—the current is of the right strength; and if the mould be carefully replaced in the solution, the terminal contacts being maintained tight and good, it will be found that after ten or twelve hours' immersion the entire surface of the mould will have received a delicate coating of copper. To get a layer 1-16 in. thick it may be needful to continue the operation for three or even four days, or even to replace the dry cell by a fresh one, according to the size of the mould. But if, on examination, it is found that the surface of the binding wire and of the front of the mould are coated with a ruddy brownish mud, tending to fall to the bottom of the dish, and especially if bubbles of gas form on and round about the mould, it is a sign that the current is *too strong*. In this case it will be necessary to remove the anode farther away from the front of the work, or even to insert a "resistance" in the shape of a foot or two of No. 36 iron wire between the anode and the carbon terminal of the dry cell. When it is considered

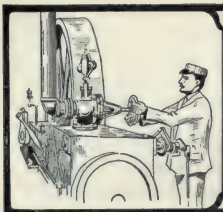
that the copper deposited has attained sufficient thickness, the mould should be removed from the sulphate of copper solution, the wire detached from the dry cell, and the mould washed for some time in a stream of running water; after which it should be slung up by its wire to dry thoroughly in a warm place. When the work is quite dry, the binding wire is untwisted, and the wire carefully unwound from round the edge of the work. If the copper deposit is very thick at these points it will be advisable to file it down cautiously all round, so as to avoid breaking away any of the copper deposited on the front. Having thus filed away any copper that may have extended round the edges of the work, the front of the mould should be held for a few seconds before a clear fire so as to warm the copper coating. This will cause it to expand slightly, after which, by cautiously pushing with the fingers from the back of the mould, the copper coating or "electrotype" can easily be detached. It may then be washed and brushed up with a soft nail-brush and soap and water, dried and mounted on velvet; or it may be "bronzed" with blacklead, or lacquered, if it is desired to preserve the beautiful surface it presents when first detached from the mould. The work or mould, if soiled with blacklead, may be cleaned with a soft tooth-brush moistened with benzine. It may be necessary after this to brush up with soap and water, using a fresh, clean brush.

Facsimile Duplicates

When it is desired to produce a facsimile of the article to be copied, a trifling

modification must be made in the manipulation. This consists essentially in preparing, first, a wax mould or cast from the original, from which mould the copper electrotype is produced. To this end, take a strip of paper long enough to make four or five turns round the sides of the object to be copied. This must be bound round the edge so as to extend up above the face of the work to a height of nearly half an inch, and tied tightly round the sides. The whole should now be laid on a flat table, face upwards. Sufficient good beeswax to cover the face of the work to a depth of about $\frac{3}{8}$ in. is now melted in a perfectly clean pipkin or ladle. The surface of the work and the inside of the paper binder are now heavily breathed upon, so as to prevent the wax adhering, when the melted wax is immediately poured in to a depth, as we have said, of about $\frac{3}{8}$ in. The mould should now be allowed to stand for an hour or two to set and harden thoroughly. The paper binder is then removed, the wax mould pulled off, three or four turns of No. 20 wire bound round the edge, and the surface and edge of the mould carefully blacklead with a very soft camel-hair brush. It will not be advisable to wet the blacklead; but, using fine powder, breathing on the mould will suffice to render the surface sufficiently adhesive to take a good polish. The blacklead mould is now to be treated precisely as recommended for the reversed facsimile. In the accompanying diagram are shown sectionally the proper position and connections of dry cell, wire to anode, depositing dish, mould, and wire from mould to negative pole of cell.





ENGINEERING PROGRESS

The Rebuilding of Baltimore

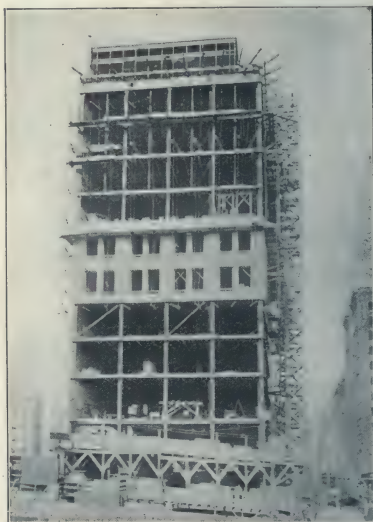
THE WORK OF REPAIRING some of the office buildings which were damaged in the fire in Baltimore in February last, has begun. The structures referred to were of the class ordinarily termed "fireproof." The reports of experts employed by the insurance companies to appraise the damages, showed that in most of the buildings the principal columns and girders composing the skele-

Repairs have progressed far enough on some of the buildings to give an idea of the extent of the exterior work required. The structure shown in the accompanying illustrations is the Union Trust Building, which was among those that had



UNION TRUST BUILDING, BALTIMORE, MD.

Located in the Recent Fire Zone.



REPAIRS UNDER WAY.

Union Trust Building, Baltimore.

tons were practically unharmed. In the majority of cases, however, the exterior walls were so affected that they will have to be stripped away from the skeleton.

been erected recently. It contains ten floors, and was faced with terra-cotta and buff brick above the stonework of the first story. Occupying a corner of two of the principal streets, two sides of the building were ornamented; and these sides were directly exposed to the conflagration. An examination showed the necessity of taking down all of the exterior walls on these sides. After the material was removed, however, the metal

work was found to have been not even discolored—in fact it was apparently entirely unharmed. A facing of pressed brick is being substituted for most of the terra-cotta, but some of the latter will still be used on the lower stories. All of the floors must also be replaced.

The total damage to this structure was estimated at between 35 and 40 per cent of its entire cost. The photographs show it immediately after the fire. (side view), and after the facing was removed and the brick work begun. (front view).

A Unique Telegraph Office

ONE RESULT of the recent great fire in Baltimore was to burn all of the telegraph offices in the busiest part of the city. It was supposed that all of the wires extending to this section were also disconnected by the fire effects; but on the day after the conflagration, an electrician, making tests, found one wire which connected with New York City. A set of instruments was immediately secured. The wire ex-



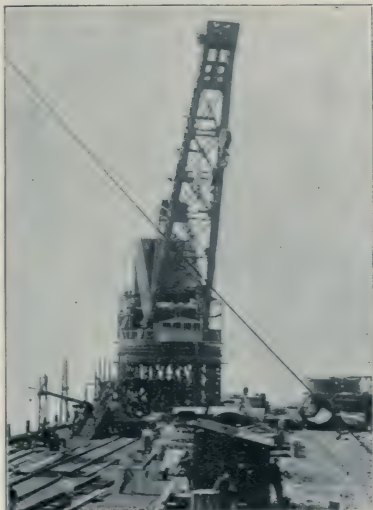
A UNIQUE TELEGRAPH STATION.

The first established in the "fire zone" at Baltimore after the recent conflagration.

tended along the trunk of a fallen telegraph pole, and messages were sent from this novel telegraph station to the metropolis. This was the first office opened in the business district after the disaster. The accompanying photograph shows an operator sending a message.

Greatest Lifting Machine

WHAT IS BELIEVED TO BE the most powerful lifting machine in the United States is located at Newport News, Va., in the great shipyard at that point. It is utilized for transferring heavy portions of a vessel, such as armor-plates, engines, guns, etc., from the wharf to their positions in the hull. The machine



MONSTER CIRCULAR DERRICK.

is known as a circular derrick, and is operated entirely by electric power. It has actually raised a weight of over 150 tons, swinging it around a circle 147 feet in diameter. Loads weighing seventy tons have been lifted and swung in a circle of 207 feet. The derrick will lift the heaviest cannon to a height of 100 feet above the surface of the water, and yet its machinery is so simple that but two men are required to operate it.

This derrick is composed of a steel tower or framework carried on pile foundations. This tower, which is circular, is fitted with a track for the rollers that carry the movable or revolving portion of the derrick. The revolving portion consists of a heavily framed structure, circular in general form, and carry-

ing a movable jib from the outer end of which the several hoisting blocks descend vertically. The revolving portion of the derrick carries all the motors and machinery required for the various movements, as well as the balancing weights required to offset the tilting tendency of the jib. The revolution of the derrick is effected by means of two pinions,

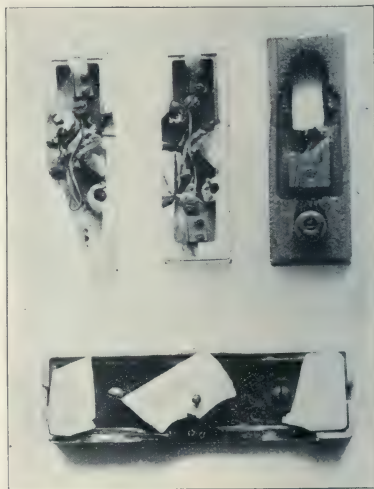


LIFTING MACHINE IN OPERATION.

which engage with a circular rack fixed to the stationary tower or framework. Each of these pinions is driven by a General Electric motor, capable of developing 20 horse-power. The racking movement of the jib is effected by means of wire ropes leading over sheaves at the top of the jib, and wound on large drums, which are located in the revolving structure of the derrick. The inner and lower end of the jib has a pin connection to the revolving structure, so that, by winding up to the drum, the outer end is raised and is brought in toward the center, while unwinding the drum lowers the outer end and moves it out from the center. The hoisting blocks are carried, as before mentioned, from the outer end of the jib; and the leads from these blocks run down the jib to drums, which, like the others, are operated by electric motors.

Dangers of Imperfect Insulation

THE USE of electrical apparatus is so prevalent that, as is well known, a large number of fires originate from the electric current. Investigations made by insurance men prove that much of the so-called insulation intended to protect inflammable material from the action of the electric current is so poor that it affords little or no protection, while some of the currents are of such voltage that ordinary insulation is no safeguard whatever. The accompanying photographs give an idea of the destruction caused by inadequate electrical work. The first photograph shows a number of fuse cut-outs which were placed on a 500-volt circuit. These were constructed with a porcelain base, but the insulation was not sufficient to prevent the current from communicating with wiring and woodwork about the cut-outs, with the result that a fire ensued which caused a loss of \$25,000. While investigating the cause of the fire, the ex-



FUSE CUT-OUTS, 500-VOLT CIRCUIT.

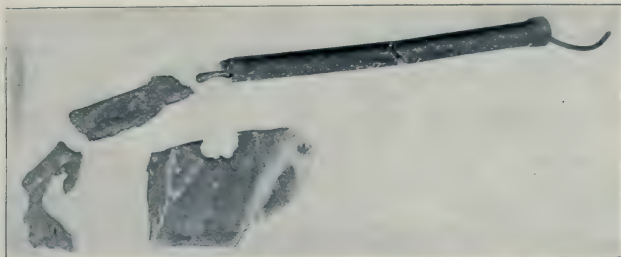
Showing Results of Defective Insulation.

perts found the cut-outs in the condition shown in the picture, and sought no further to trace the origin of the trouble.

The second picture shows the way in which insulated wire will become defective. In this case not only was the

wire exposed to the weather, being on the outside of a building, but some one had thoughtlessly or maliciously cut through the insulation with a knife. The wire conveyed a powerful electric current for

of brick 450 feet long, 186 feet wide, and three stories high. Rising from the center of the structure are four chimney shafts, each 275 feet high, said to be the tallest in Europe. Their huge diameter



SHOWING HOW INSULATED WIRE WILL BECOME DEFECTIVE.

lighting. Leaking through the insulation where it had worn away, and through the cut, the current destroyed an office building in Buffalo, New York, causing a loss of about \$60,000. The damaged part of the wire could have been replaced at an actual cost of less than \$1, and the fire thereby averted, had the wiring been inspected properly. The photographs were taken by insurance inspectors who investigated the causes of the fires.—D. A. W.

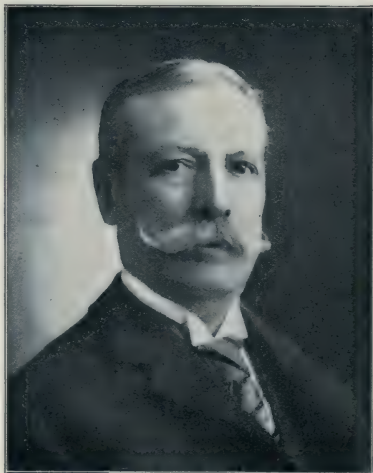
Yerkes Builds World's Greatest Power Plant

AN AMERICAN — Charles T. Yerkes—is building for the city of London the greatest power plant in the world. It is now nearing completion, and in less than a year will be driving trains all over the city. The plant is being erected on the south of the Thames, near Chelsea, and is to supply electricity to the District Railway, the Baker Street & Waterloo line, and the Great Northern, Brompton & Piccadilly Railway. For emergency purposes it will also be connected with the "Tube" from Shepherd's Bush and Mansion House and with the Metropolitan District Railway.

The plant will be about twice the size of that at Niagara, and will cost over \$10,000,000. The building is a rectangle

is one of the wonders of London. They are 19 feet across at the top, and are ascended from the interior by means of iron "dogs" let into the brick work.

The building is divided lengthwise into two portions. On the side nearest the



CHARLES T. YERKES.

river are to be found the 64 great Babcock & Wilcox boilers. They are laid in two tiers, and the floor above is occupied by the coal bunkers. The furnaces are supplied with mechanical stokers, and the

steam from the boilers will be superheated. The boilers represent about 1,200 horse-power each.

In the north side of the building are the turbine and generator sets. There will be eight turbines working eight generator sets in all, and space will be left for two more to be put in later. They have a capacity of 5,000 kilowatts each, and are by far the most powerful in England. These 40,000 kilowatts, together with an auxiliary plant for condensers and exciter sets, will represent in all in driving power some 600,000 horse-power. The electric pressure at the station will be 11,000 volts, alternating current, which will be subdued by rotary converters and transformers to 400 volts, direct current, at the different substations.

The enormous stators in the generating sets weigh 50 tons each. All were built by the Westinghouse Company. Four were made at Pittsburgh and four at Trafford Park, Manchester. Inside the stators, motors revolve at a tremendous pace, and the current is collected on three slip rings. Above the turbine level are switchboard galleries for high tension, and at the east end of the turbine level similar galleries for "exciter" sets and station lighting and for low-tension stators and motors.

In the construction nearly 20,000 tons of steel have been used. The foundations have been sunk to 40 feet below the land level, and consist of brick lying on concrete, which in its turn lies on the blue clay.

Outside the building is a large basin constructed beside the river especially for barges bringing coal to the station. The basin accommodates eight of these barges. A temporary conveyor will carry the coal from the barges to the great conveyor built of laced steel against the main building, which will take the coal to the bunkers in the roof of the station. By means of these same conveyors, all ashes will be taken back to other barges. Close by the docks are water filters in brick towers, their object being to treat the water used and thus prevent "furring" of boilers.

Mr. Yerkes is a Chicagoan, and it was in Chicago that he received his schooling

in municipal railway affairs. He built most of the Chicago street-car lines, and he is adopting the same system of avoiding congestion of traffic in London which he so successfully employed in the western metropolis.



Proposed Endless Street-Car

A CONTINUOUS TRAIN OF SEATS on a moving sidewalk has been suggested as the method of solving the transportation problem of New York and Chicago. The device is something of an endless street-car which the passenger can enter anywhere he desires. It is proposed to use the system in New York in connecting the Manhattan terminals of the three great bridges over the East River with one another, and with the subway and elevated railroads, as well as with the principal surface lines running north and south. The moving seats are simply an improvement on the moving sidewalks and continuous trains of the Chicago World's Fair and Paris Exposition. Two "stepping" platforms run alongside the train platform. The first moves at a rate of about three miles



ENDLESS STREET CAR.

Consisting of Train of Seats on Moving Sidewalk.

an hour, and the other at six miles an hour. The passenger steps from the ground to the slower platform; then to the one moving at six miles an hour; and finally to the platform containing the seats, which is moving at nine miles an hour. The seats are designed to hold three persons, and are placed three feet apart.

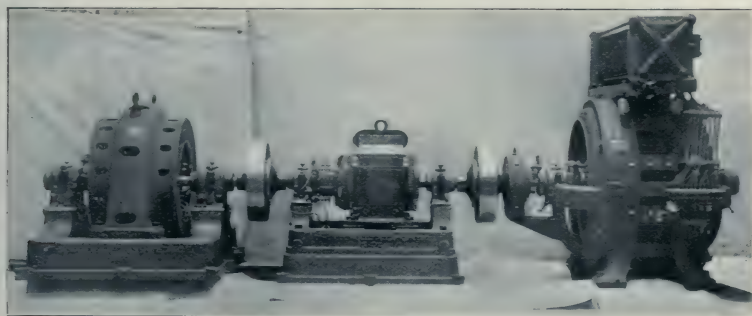
An Interesting Continuous-Current Dynamo

THE *Compagnie de l'Industrie Electrique et Mécanique*, Geneva, Switzerland, some time ago built an interesting dynamo to be used in the tests of the aerial power transmission line between Saint Maurice and Lausanne, this machine enabling tensions as high as 23,000 volts to be attained with continuous current.

Now a similar machine has been constructed by the same company, for the Vienna (Austria) Polytechnical High School. This machine, which is able to yield currents of an intensity of 1 am-

per, is wound on a special lined paper. Each individual coil includes 500 silk-insulated copper-wire windings, one-half millimeter in diameter. There are, accordingly, 24,000 armature windings, the resistance of which during operation is 700 ohms, and which are capable of yielding a current intensity of 1 ampere in normal working order. These coils are readily fixed in position or withdrawn from the grooves of the armature.

The collector, comprising 96 segments separated by an air gap, is fixed, in opposition to the general practice with ordinary dynamos. The continuous current is collected by means of two small



AN INTERESTING BIPOLAR CONTINUOUS-CURRENT DYNAMO.
Capable of giving tension of 23,000 volts at normal speed of 600 revolutions.

per, under tensions ranging between 20,000 and 25,000 volts, at an angular speed ranging between 600 and 700 revolutions, is excited by means of a small exciting machine mounted on the end of the shaft and supplying current at a tension of 110 volts.

The problem solved in connection with both these machines was a rather difficult one, as the highest tensions so far obtained with continuous current hardly attained 10,000 volts.

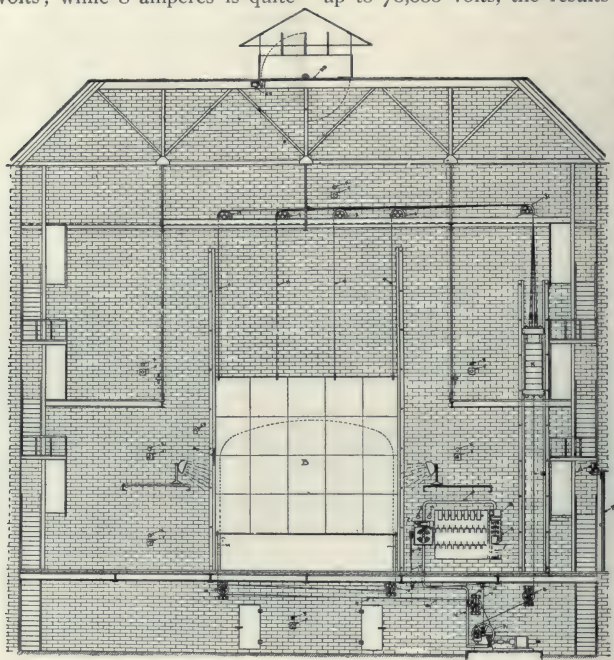
The latter machine, as pictured herewith, is a bipolar dynamo resembling externally a modern radial pole alternator. The inductor, being made of laminated iron, rotates in the interior of a ring consisting of two pieces and constituting the armature; the latter, accordingly, is fixed. The armature coils, numbering 48, are fitted into an equal number of slots in the ring, being insulated by means of a

metallic brushes, sliding in the interior of its surface. In order to avoid any risk of arcs being produced between the segments of the collector on account of the high-potential difference between each two of them (500 volts as an average), a small blowing device has been provided, mounted at the end of the shaft of the pulley controlling the exciting machine. By means of two nozzles directed towards the brushes, strong air currents are made to blow out any arcs produced between the segments. As, however, with any higher intensity, there would still be a risk of short circuits, a condenser was branched off in shunt between each plate of the collector; this arrangement, which has given most satisfactory results, was patented by the company.

The exciting current, as above said, is supplied by a small dynamo as in the case of an ordinary alternator; this

dynamo is carefully insulated from the ground, like the rheostat regulating the exciting current. The maximum value of the exciting current is 14 amperes with 80 volts; while 8 amperes is quite

By combining three similar machines, the above company was able to effect a series of interesting tests, with continuous and alternating currents of tensions up to 70,000 volts, the results of which



SECTION OF STAGE, LOOKING TOWARD AUDIENCE.

sufficient for giving a tension of 23,000 volts at the normal speed of 600 turns.

While in the first machine of this type the tension was during some minutes raised up to 23,000 volts, a tension as high as 25,000 volts was readily obtained with the dynamo constructed for the Vienna High School.

The internal bore of the armature is 58 centimeters. The peripheral speed of the inductor, with 600 revolutions, is, accordingly, 18.22 meters per second, which is a rather low figure.

The machine is driven by a 440-volt 70- to 80-ampere electro-motor, a special feature of which is the fact that its speed may be varied within wide limits so as to allow of different periods in the alternator.

will be forthcoming in the near future.—
DR. A. GRADENWITZ.

Electrically Operated Theater Curtain

IN CHICAGO the extraordinary safety precautions resulting from the Iroquois fire have brought forth a combination steel and asbestos theater curtain, as staunch and fireproof as the proscenium wall itself, which has to be operated by electric power because of its excessive weight. The power apparatus for raising and lowering the curtain has proved so efficient and convenient that theater managers now wonder how they ever tolerated the old system of hand-power curtains.

The illustration shows the method of operation. It represents a section of a theater stage, looking toward the audience. B is a curtain suspended through the cables H, passing over the sheaves I and J to the counterweight K. The electrical hoisting machine is in the basement, and is shown at A. Attached to the lower end of the weight K is the cable L, passing around the sheave S to the drum A. The two cables are attached to the bottom of the curtain, and, after passing downward over the sheaves N and O, are joined through P to the cable Q, passing around the winding drum A. When one of the cables is wound on the drum the other is unwound. The drum is rotated by means of an electric motor, controlled by the operation of the handle C of the controller.

By a pull of the cable T through the lever D, located on the stage floor, the drum A of the winding mechanism is released and allowed to revolve freely about its shaft. The curtain is slightly under counterweighted, so that, when in its uppermost position, if the drum A is released, it will descend because of its excessive weight.

The curtain is released by the first pull of the lever D. Another pull presses brake shoes on the inside of the drum A, so that the descent may be controlled as to its speed or stopped. A safeguard against the failure of the electric power

is thus formed by the releasing of the drum.

In addition there is a system of push-button control. The curtain may be sent down by merely pressing the button F, which operates the solenoid switch E. The operation of the switch E connects the motor of the machine so as to rotate the drum A in a direction to lower the curtain at its greatest speed, the motor being automatically cut out of the circuit when the curtain has reached the stage floor. The conduit W carries the electric connection between the controller and the switch E. In case of a failure of the house current, a switch G automatically connects the hoisting motor with an outside station or storage battery plant.

To prevent tampering by irresponsible persons, the push buttons F are inclosed in a box X which has an easily perforated front. When the buttons F are operated, inconspicuous pilot lights glow, giving a silent warning to theater attachés to be on the alert. When the curtain is sent down by means of the push buttons, a bell or buzzer E E is operated through an attachment F F, giving warning to those on the stage to avoid the lowering curtain. The solenoid C C is connected in circuit with the push button F, as is also the solenoid A A, so that in case of an emergency the pushing of the button F will instantly open the ventilator and the door B B.



Life Stories of Successful Men

F. Augustus Heinze

By HENRY M. HYDE

Editorial Writer on the *Chicago Tribune*

AT THE AGE of thirty-seven worth \$20,000,000; recognized as one of the most dangerous rivals the great copper "trust" and the Standard Oil mining interests have ever had to face; head of one of the two great factions which have kept the politics of Montana in a turmoil for years; owner of immense smelters and extremely rich mines; hiding behind a smooth-shaven, almost boyish face, a tremendous power over thousands of men—surely these are qualities which make the life story of F. Augustus Heinze of intense interest to every ambitious young man.

It is impossible to admire or to endorse some of the tactics which Heinze has adopted in his fight with the giants of the financial world. But he would plead, in excuse or extenuation, that he has been in the thick of a life or death battle, and that it has been necessary for him to fight the devil with fire.

At any rate it should be interesting to see if one can lay his hands on the secret of Heinze's power. To him who reads the story intelligently, that bottom secret is not far to seek. It really is not a secret at all. It is the same quality which is to be found at the bottom of so many stories of great success that it has become almost a commonplace.

In 1867 Fritz Augustus Heinze was born in Brooklyn, N. Y., the son of a retired business man in comfortable circumstances. He attended the public schools. One day he came home mad.

"Mother," he said, "I am going to call myself Augustus after this."

"Why?" she asked, smiling.

"Because the boys all call me 'Dutch Fritz,' and I don't like it."

So that trivial, boyish incident explains why it has been F. Augustus ever since.

Heinze's parents were able to give their son the best educational advantages.

He graduated from the Columbia School of Mines and Mining in 1889, and the same year he turned up in Butte, Montana, looking for work in the line of his profession. Butte was then in its infancy as a mining camp. The great deposits of copper which have since made the district one of the richest and most prosperous in the world, were just beginning to be tapped in a small way. It was a wonderful opportunity for a young man who knew how to use his eyes, and who had the requisite technical knowledge behind them.

Heinze got a job as surveyor with one of the mining companies. His work took him all over the mining district, but he did much more than carry a chain and drive stakes to mark the boundaries of mining claims. He saw and he stored away in his mind impressions of the fabulous and undeveloped riches hidden under the rocky soil. Wages were fairly high in those times—Heinze drew \$5 a day—but that promised little prospect of getting together enough money to start in business for himself. But, all the while, the ambition to put his knowledge to his own use was burning within him.

Finally, when he had been working as a surveyor for two years, and had acquired a thorough, first-hand knowledge of most of the mining country about Butte, his grandmother died, and left him a legacy of \$50,000. Here, then, was an opportunity to start a mining company on his own account. But Heinze did not take it—at least not directly and immediately. There were men and companies in Butte already who had much more capital and as good a general knowledge of conditions. If he was to meet them in competition on anywhere near an even basis, he must get an advantage over them in some other direction. He was already a graduate of the Columbia School of

Mines; but he knew that in certain German schools some of the processes of reducing ores had been recently carried to a still higher state of perfection. If he could learn these processes, and so produce metal more economically than the other Butte copper miners, the disadvantage caused by his smaller capital might be more than made up.

So Heinze bade Butte good-bye for a time, and sailed for Germany. There he took a complete course in engineering and metallurgy; and when he came back, he felt himself ready for the battle which he knew would follow his invasion of the Butte field. He hunted up some of his old fellow-students at the Columbia School of Mines—it would do no harm to have as much technical knowledge as possible—and among them they organized a mining company with a capital of \$250,000. Heinze put in his own \$50,000; his associates added what they could control; and they were able to interest outside capital, which was impressed with the story of the young man's thorough preparation for the coming struggle.

Then Heinze invaded Butte for a second time. First of all, he built a big reducing plant for the handling of copper ore. He put into this plant all the new "tricks of the trade" which he had learned in Germany, together with others which he and his fellow mining engineers had studied out. One of them was a new method of roasting copper ore, which has since been adopted by all the plants in Butte. Starting with these advantages in the way of economical production, the new mill was a paying investment from the start.

Then Heinze began to look around for mines which looked like good purchases. In this work his expert knowledge of conditions, acquired during his service as a surveyor around the camp, proved extremely valuable. A good many men had sunk a lot of money in trying to develop mines, and had failed to make them pay, because of the lack of this very first-hand knowledge which Heinze possessed. He bought several of these abandoned properties, and, one after the other, almost without exception, he made them pay. That naturally aroused the anger of his less successful rivals. They thought

there was something almost magical about the young man's operations. There wasn't. He knew his business, from the ground up and all the way through. That was all.

All this time Heinze and his company were making much money and making it rapidly. Presently he cast his eyes over into British Columbia, where hundreds of thousands of dollars had been sunk in a vain effort to develop valuable mines. He took his keen observation and his technical skill across the border, and bought a lot of the abandoned claims. The claims held rich ore and Heinze knew it. He built a reducing mill, started to open up the mines, started to construct a railroad to haul his ore to market or to where it could reach a through railroad line. Then the Canadians became badly scared. They were not willing that this young Yankee should come over and rob them of their mineral wealth. They offered him a big price for his holdings. Heinze accepted, and his company cleared a huge profit on the undertaking.

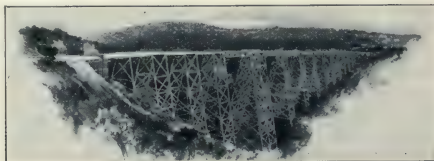
He came on back to Butte, where his enterprises were still growing rapidly. There were plenty of opportunities and plenty of work to be done there, anyhow. Marcus Daly was then, as he remained until the end of his life, one of the copper kings of Butte. He had poured many thousands into a hole in the ground, and had found nothing worth while. Heinze had been down in that hole himself; and he knew more about its prospects than even Daly, shrewd as the latter was. Daly was anxious to sell. Heinze was ready to buy. The deal was made, with the proviso that, if the abandoned claim finally proved profitable, Heinze was to pay Daly back the money he had spent in opening it up.

Within two weeks after he took control of the Daly claim, Heinze had struck one of the three richest deposits of copper in the world. Daly rushed into court with a petition asking that the sale be set aside and that the control and possession of the mine be turned over to him. Heinze, of course, fought it, and so he became entangled in a web of litigation which has ever since spread its coils over the State of Montana and has caused innumerable scandals. These scandals have involved

the courts, the peace officers, and even the Legislature of the State. Their echoes have been heard all over the country, and have even invaded the Senate of the United States.

But the history of the scandals growing out of the bitter war between the copper kings of Montana, is a story by itself. And it is not a pleasant one. It

is sufficient for the present purpose to point out again, that Heinze's rise to power is directly due to the fact that he was an expert engineer and metallurgist, and that he was able to meet competition and to beat it, first of all, on the perfectly proper ground of being in possession of a more thorough technical education and training.



Chocolate-Colored Wit

I DON'T set down,
En fol' my han's,
Waitin' fer de music
Of de good-time ban's;
But I rise up airy
W'en de black night go,
En I lights in de furrer,
En I hoes my row.

"Uncle John, can you tell what time it is by that thermometer?" "Yes, Sah—wintah-time."

"Misery may like company," says a colored philosopher, "but I'd rader hab the reumatiz in one leg den hab it in de bof."

DOLPHUS—"Dat am a fine turkey yo' got, Rastus. Am it dry picked?"

RASTUS—"No, Dolphus, hit wah rainin' wery ha'd when I picked dat bird."

An old negro preacher divided his sermon into two parts—"Fust, all de things in de text; and second, all de things not in de text; and, Bredren, we'll wrastle with the second part fust."

CUSTOMER (getting his hair cut)—"Didn't you nip off a piece of de ear then?"

BARBER (reassuringly)—"Yes, Sah, a small piece, but not 'nough to affect de hearin', Sah."

"What dat, Judge, yer ax me what my wocashun am?"

"Yes, what is your vocation? I mean, what do you do for a living?"

"Ah, yesser, yesser, I understands yer now. Wat I does for a livin' is—my wife takes in washing."

FARMER—"Hi, there! Can't you see that sign, 'No fishing on these grounds'?"

COLORED FISHERMAN—"Co'se I kin see the sign. I'se cullid, Boss, but I ain't so ignorant as ter fish on no grounds. I'm fishin' in de crick."

An old darkey of Charleston, South Carolina, was fully impressed with the importance of the exigency when, between the shocks of the earthquake in that city, he prayed: "O Lord, come down here now yerself, and doan send any of yer family, kase dis ain't no boy's play."

"Good Heavens, Washington, how does your master live in such a mosquitoey hole as this?"

"Well, Sar, the fact am, at night Mars George am so intoxicated he don't give a cuss for the skeeters, and in de morning de skeeters am so intoxicated, they don't give a cuss for Mars George."

De good Lawd make us thankful fer what we about ter receive; but fer Heaven's sake keep us out de hands of de receivers.

Lots of folks is as stubborn as what de mule is, and not half so useful in plowin' time.

The Sleeping Sickness

Solution of the Mystery of the Deadly Slumber from which No Victim Ever Awakes

By PAUL ARR

IN THE KONGO the natives have for three years past been afflicted with a mysterious, deadly ailment, called the "sleeping sickness." The victim at first displays extreme drowsiness, and then is overcome by an uncontrollable desire to sleep while at work or play. He falls asleep at his meals, and, when on a journey—no matter of how great importance—will lie down by the roadside and sleep until awakened. At length it becomes difficult to arouse him, then more difficult and still more difficult, until finally he sinks into the sleep from which there is no waking. No one stricken with the disease has ever recovered. It has wiped out whole towns and neighborhoods of the negroes during the three years of its terrible ravages. Scientists have gone from all parts of Europe to study the malady, but its origin has until very recently remained a deep mystery.

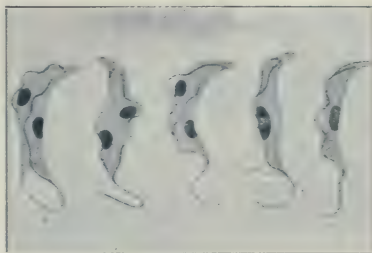


GLOSSINA PALPALIS.

These flies carry the fatal parasite. Reproduced from specimens in the South Kensington Museum.

Col. David Bruce, of the British Army Medical Corps, formerly stationed in Zululand, has discovered that the affliction is caused by the bite of a fly—the Tsetse fly, which Livingstone and other African explorers describe as creating so

much havoc among the horses of exploring expeditions in the Dark Continent. Until the recent outbreak of the disease, however, man was thought to rest secure from the terrible affliction. Now the fear



TRYPANOSOMA.

These parasites are carried by the tsetse fly, and deposited in sufferers, causing sleeping sickness.

has arisen that the ailment may become general among both the white and native inhabitants of Africa. Already the captain of a British vessel has met death from the disease, and several white residents of Uganda have been afflicted with the usual results. No living thing that has been bitten by the tsetse fly—save the immune ox—has ever recovered.

It has been found that it is not the actual bite of the fly that is poisonous, but the fly deposits in one animal a microbe—the *Trypanosoma*—which it has sucked from the blood of another animal. This same microbe is found in ordinary sewer rats of Chicago and New York, but has hitherto been regarded as harmless. In rats the *Trypanosoma* is revealed under the microscope to be a worm-like microbe which dashes about at an extraordinary rate, causing everywhere a violent commotion by the lashing of a whip which it possesses at its anterior end. Rats appear to treat this unruly parasite with indifference. No harm is known ever to have been caused by this

microbe in the rat. The tsetse fly in Africa is believed to get the microbe from large wild animals such as the koodoo, impala, and buffalo. It is known to inhabit all the regions where these animals are found. The fly is merely a go-between which carries the *Trypanosoma* from the African wild beasts, in which it seems to be harmless, to the domestic animal and human body, in which it causes unfailing death.

In animals the disease caused by the fly's bite is known as Nagana. In the



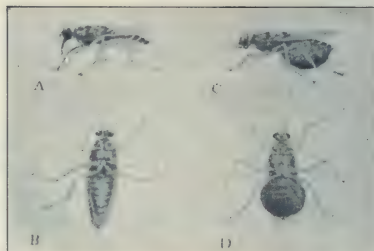
EXAMINING A PATIENT SUFFERING WITH SLEEPING SICKNESS.

Doctors puncturing the spinal column in which the *Trypanosoma* exists.

vast area of the Gran Chaco, where the pampas of Argentina, Bolivia, Paraguay, and Brazil meet, the *Trypanosoma* of Mal de Caderas has swept tens of thousands of horses off the face of the earth; and in many regions the bandy-legged Gaucho bemoans the loss of his horse, whose place has been taken by the humble but immune ox. The *Trypanosoma* of Dourine is also universally fatal to horses.

The tsetse fly is supposed to have been brought to Uganda by Emin Pasha's followers after their relief by Stanley in the eighties. It gained such a foothold in so short a time, and created so much havoc among the natives, that the Royal Society sent out an expedition for the study of the malady. Inquiry showed that the area affected was principally along the

Busoga and Kavirondo shores of Lake Victoria. In the islands the mortality had been terrible. A laboratory was established at Entebbe, and study was begun. But the task was difficult, and the problem seemed no nearer solution when Colonel Bruce was despatched to investigate and elucidate the problem. With his wife, who had also accompanied him to Zululand, the Colonel soon discovered that the *Trypanosoma* was found in every case of the disease; it was not found in persons not suffering from the disease. It was present in the blood. Only a blood-sucker could put it there. Examination soon revealed the fly—a tsetse fly—differing but slightly from the old tsetse of Zululand. Natives were instructed to collect the flies, which soon



TSETSE FLIES (*Glossina morsitans*) BEFORE AND AFTER BECOMING INFECTED BY ABSORBING THE BLOOD OF A SLEEPING-SICKNESS PATIENT.

began to arrive in packets by the hundreds every day. The geographical distribution of the fly was found to correspond exactly with that of the disease.

The *Sphere*, of London, in commenting on the discovery, says:

"The importance of these researches can scarcely be overestimated. We may still be a long way off the cure, but the cause is known. The harmless parasite of the rat has led to the discovery of others which have been shown to be the most deadly of all microbes that infect man and animals. Science may yet rid Uganda—perhaps the best of all our African possessions—of this terrible curse which affects its inhabitants."



A Poor Boy's Country

Extracts from Address Delivered at Second Annual Reception Tendered
by Armour Institute of Technology to Students of the American
School of Correspondence, June 17, 1904

By HON. JONATHAN P. DOLLIVER

Junior United States Senator from Iowa.



I AM TO SPEAK for a little while upon the country in which we live, with a special reference to its present opportunities for young people to fight successfully the battle of life; and, if you will allow me, I intend to approach the subject through something specially suggested by the biography of the late President of the United States.

Every human life has an important significance. There are some lives lifted up so that all generations of men may see them and mark out the spirit and significance that lie in them; but the thing that I desire to speak of in connection with the life of William McKinley is the lesson that may be learned from such a man, who, without any outside assistance, without disturbing the institutions of society, made his way from an humble situation in life until, before he was sixty, he stood upon the highest eminence known among men.

There has grown up within our lifetime a school of thinkers and critics who teach that the world we are in is hardly fit to live in; and that, before the poor shall have a chance, it is first necessary to subvert the old institutions of society and bring in a new order of things—a benevolent *régime*. I like the life of McKinley because it rebukes this thought. I believe the longer I live, the less sympathy I have for the children of the poor. I am saving my sympathies now—all that I have to spare—for the children of the rich.

McKinley was not born in abject poverty. He was one of a family of children born on the average level of life, where nearly every one else is born. He was born upon the average plane of life

which has given to the world practically every important personage in history.

Emerson was right when he said that the only way to study the history of the world is to study the lives of the men who have made history. I tried this method and started with the life of Napoleon, but I had not read ten pages before I came to the conclusion that he wasn't in *our* class at all!—that he was not a man, but a monstrosity, the like of which never got into the world before, and, fortunately for mankind, is not likely to again. I had the same experience in reading Carlyle's "Life of Oliver Cromwell." To this day I cannot pick that book up and mark the gulf which seems to be fixed between the man's preparation and what he did, without a strange sensation creeping over me that the story is not about a man at all. But when you come to the case of William McKinley everything looks reasonable. There is nothing but what almost anyone might have done. No one pretends that he ranked high as a student in school; no one pretends that he was an extraordinary soldier in the field. He went out as a private, and came back hardly more than a private. I have always had a kind of satisfaction in the life of McKinley—that he died as he had lived, shoulder to shoulder with more than a million men in the United States. He was not a great lawyer. You cannot find a trace of any record connecting his name with any prominent case. He was not an extraordinary member of Congress. The thing that made more impression than anything else was the fact that no one seemed to envy him a single faculty that he had. He gained the po-

sition which he held in the House, not through any great act that he initiated, but by simply holding his place and rising to a position of leadership by reason of long service. To this day, while the sum of his achievements is great, there is no trace of a record connecting the name of McKinley with any extraordinary parliamentary proceeding. He lived an average life, hardly appearing to have taken a single step that nearly every one else under favorable circumstances might not have taken. That is why I like the biography of McKinley—to answer every humbug philosophy of human life aiming to overthrow the institutions of society in order to give the poor a better opportunity. The Lord seems to have arranged this world in such a way that no one appears to amount to anything unless he *does something*, and no one does anything except those of us who have to; therefore the poor boy is the only boy who ever had a chance, or who ever can have a chance, to do anything. If you give a boy \$50,000, you run the risk of simply ruining him for life. He is fully satisfied and does not start. He simply coils himself up on the door-mat, and it requires more than parental energy to kick him into the street. So I would suggest to you the propriety of keeping the two as far as possible out of each other's way. It will be better for the boy, and, in the long run, better for the \$50,000. If there are girls in the family, why, of course, that is somewhat different. On account of the uneven way in which society has got itself divided, it is well to give the girls half of the money; but take the rest, and give it to some institution of learning that shall help to save the world; and let the boys fight the battle of life as you have fought it. * * *

The law of human life is not a law of ease, not a law of deliverance of any kind. The law of human life is a law of labor, of sacrifice, of service; and that man renders this poor old world of ours a mean turn who tries to take away the means by which the strongest manhood is made.

A year or so ago I went to Kentucky to make a political speech; and when I got through, the boys said they wanted to entertain me. I thought they intended

to entertain me on peculiar Kentucky lines. I said, "Gentlemen, there is one thing in Kentucky I should like to see. Down on the edge of Hardin County there is a cabin in which the mother of Abraham Lincoln was living when he was born. I should like to visit that spot." We started; and the next day, toward sundown, we came to Hardin County, and I found myself standing, with hat in hand, in reverence before all that is left of that rude cabin which sheltered the infancy of the grandest man that ever lived in the most trying of times. That cabin is more royal than all the palaces of the earth. It did not shelter the child of a king; but there is something more royal than a king—it is a *man*. For hours I stood there; and I said to myself, "This is the American type of royalty." You can turn the pages of history and not find a name that does not have a background of poverty and hard work—from Washington down to our own times. Every one came up to that honor through the tribulations of poverty. William J. Bryan is no exception to that rule. He had a hard struggle in his younger days. He has served a good many years in the House of Representatives, where I have known him well, and I use him to illustrate the unlimited opportunity for young manhood in the United States. There, is a man hardly forty-five years old, who, without the help of money or influential connections of any kind, but by the unaided forces of his own character, has become the well-beloved leader of millions in the United States.



Not only is it true that every important public career has had that background of hardship and toil behind it—the same thing is true of every important business career. * * *

In these days there are mighty few people who are going to be President or even Vice-President of these United States. Few people are going to be presidents or even vice-presidents of railroads. The great majority of people are going to live very ordinary, humble lives in this world. My father was a Methodist preacher, and he used to say that the Lord gives to every one of us everything

that He can trust us with. Perhaps that is why so many of us have so little—fighting a hard fight and winning a very modest victory. Maybe it is all for the best, though. The accumulation of money seems to constitute what in general is regarded as a man's success in this world, but let me say to you to-night that my conviction is stronger than ever that it is not money or position that counts, but the *faithfulness* with which a man stands to the every-day business of life that lies along his pathway.

I went down to New York recently, and took occasion to see who it is down there that is doing the great business of the metropolis, our commercial capital. Before going, I put down the name of every one I had heard of, but, for fear I had not got them all, I asked a man who lived there to put down all he knew. I found that outside of a few decadent families rarely heard of except as they moved from one pleasure resort to another, there was hardly in New York City a man or a woman whose name was ever heard of, who was born there, except one—Theodore Roosevelt—and how he ever got away I never heard anyone say. With that one exception, every one of them seemed to have walked there from a farm somewhere. Tolstoi was right when he said that there is no possible strength of body, mind, or character that does not come up from the ground through the bare feet.

Before McKinley died I went with him through Iowa to the Dakotas, to meet the returning regiments of the Army. There were in the party six Senators of the United States, including those from Illinois and Iowa, seven or eight members of the House, all conspicuous in public life to-day. As we came to Iowa Falls, the President waked us all up. There were five thousand people waiting there in that early morning hour, to hear him speak; and it was as little as he could do, he said, to gratify them; so he said, "The rest of you have got to get up, too." He made one of the best speeches he ever

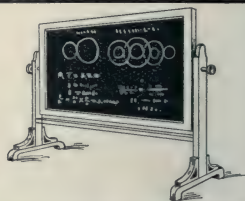
made, I believe, though it was never reported at all. After breakfast we all went back to the smoking car, when we noticed a peculiar smile on the President's face as he watched the antics of two boys by the roadside—two boys warming their feet by starting up the cows. The President said that one of the most delightful memories of his boyhood days was the luxury of warming his frost-bitten feet by scaring up the cows. "I wonder how many of you have had the same experience," he added. Beginning with John Hay, Secretary of State, who began his foot-warming in the woods of Ohio and finished on the plains of Illinois, every member of the President's Cabinet gave in the same testimony. Then followed the Governor of the State and the Senators—one after another—until the little experience meeting came to an end. So I was not surprised when I took my census of New York. Every great merchant, every noted lawyer, journalist, artist, architect, writer—every man and every woman conspicuous in any department of culture—all appeared to have walked into the town from some other place; and I made up my mind that I would never fail to bear a manly witness that this country is, and always has been, a poor boy's country.

Now and then a young man says, "What you say may have been true twenty-five years ago, but it is not so now." On the other hand, modern industrial methods in America, instead of shutting the doors of opportunity, have opened them in a thousand directions. Within twenty years every president of every great corporation will be dead, or in a sanitarium for nervous debility brought on by drawing his salary, and the directors will be running all over this world to find young men of trained ability to take up the failures and carry forward the great business enterprises of the modern world. And I say to you that there never before was a time when a man, taken by himself, stood for so much, and when a dollar stood for so little.



CHALK TALKS

by CARL S. DOW.



Number Seven—Thermometers

A THERMOMETER is an instrument for measuring intensity of heat. It consists of a glass tube of small bore, with a bulb on the end. The tube and bulb are filled with mercury, and the end sealed. The height of the mercury indicates the temperature.

Kinds

In England and in America the Fahrenheit thermometer is generally used, while in France and in most laboratories in this country the Centigrade is the accepted standard. The difference between the two lies in the graduations. There are other kinds of thermometers, such as the Réaumur; but, as they are not commonly used, we need not consider them.

Graduation

Although various arbitrary units may be adopted for the graduation of thermometers, there are two points which are fixed. These are the *boiling point* and the *freezing point* of water.

To graduate a Centigrade thermometer, it is placed in boiling water, and the height of the mercury column marked: this is called 100° . The thermometer is then held in a freezing mixture, and the height of the mercury marked 0° . The distance between these marks is divided into 100 equal parts called *degrees*.

The graduation of the Fahrenheit thermometer is accomplished in the same way. The boiling point, however, is

marked 212° , and the freezing point 32° . As shown on the blackboard, there are 180 divisions between the boiling and freezing points.

Comparison of Scales

From the blackboard we know that,

$$180^{\circ} \text{ F.} = 100^{\circ} \text{ C.}$$

$$9^{\circ} \text{ F.} = 5^{\circ} \text{ C.}$$

$$1^{\circ} \text{ F.} = \frac{5}{9}^{\circ} \text{ C.}$$

$$1^{\circ} \text{ C.} = \frac{9}{5}^{\circ} \text{ F.}$$

This is shown by the lines E F and C D.

Now, let us suppose that the two thermometers are placed side by side and subjected to the same heat. Assume the temperatures to be 176° F. and 80° C. , as shown. If heat is now applied and the mercury in the Fahrenheit thermometer rises to 194° , how high will the mercury rise in the Centigrade thermometer?

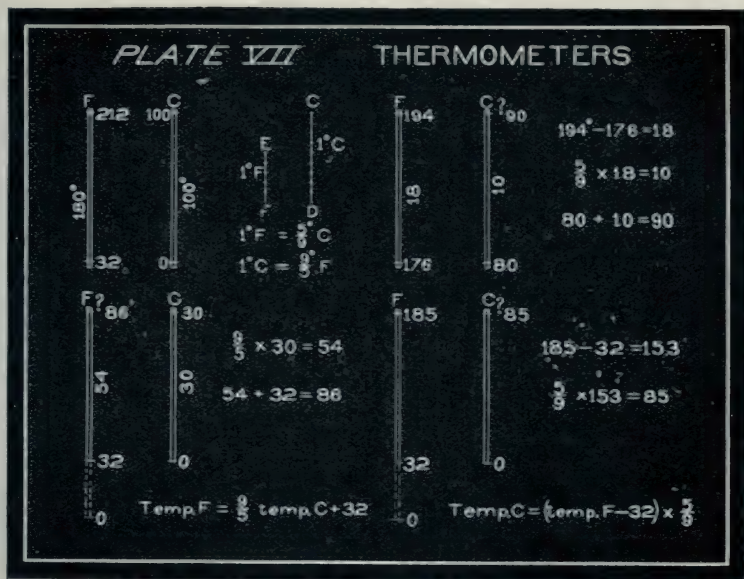
The rise in temperature F. will be $194 - 176 (= 18)$ degrees. Since a Fahrenheit degree is $\frac{5}{9}$ of a Centigrade degree,

$$18^{\circ} \text{ F.} = 10^{\circ} \text{ C.}$$

because $\frac{5}{9} \times 18 = 10$. By adding this to the original Centigrade reading, we get 90° .

Problem

In the above we simply compared a few degrees' change in a case in which the freezing points were not involved.



Now let us change one reading to another. One reading is 30°C ., and we wish to know this reading in Fahrenheit degrees. We know that a change of 30°C . is equal to $\frac{9}{5} \times 30 = 54^{\circ}\text{F}$., but the reading is not 54°F ., because the Fahrenheit freezing point is 32° above the zero. To reduce the reading, we must *add* 32° to the change in temperature:

$$32 + 54 = 86.$$

From this we may deduce the expression:

$$\text{Temp. F.} = \frac{9}{5} \text{ Temp. C.} + 32^{\circ}.$$

Another Problem

Let us reduce 185°F . to Centigrade.

As the comparison can be made only when starting from the freezing point, we must first *subtract* 32° from the Fahrenheit reading:

$$185 - 32 = 153.$$

Since

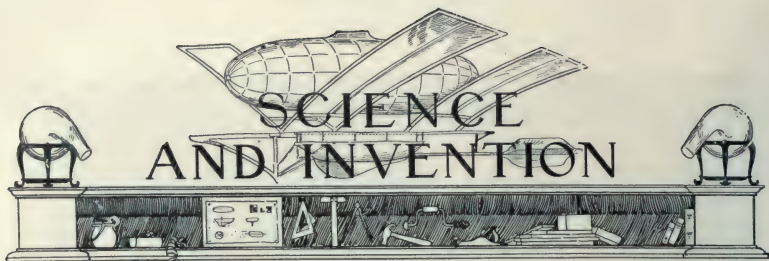
$$1^{\circ}\text{F.} = \frac{5}{9}^{\circ}\text{C.}$$

$$\frac{5}{9} \times 153 = 85.$$

From this we may deduce the expression:

$$\text{Temp. C.} = (\text{Temp. F.} - 32^{\circ}) \times \frac{5}{9}.$$





Mammoth Remains in Texas

WHILE DIGGING A WELL in the vicinity of Austin, Texas, a workman recently struck something hard with his pick at a depth of about thirty feet below the surface. The man supposed it to be a stone, and struck it several blows to dislodge it. The blows, unfortunately, caused it to break into two fragments. The object was raised to the surface with the other material of excavation, when the attention of one of the laborers was attracted to the curious ap-



PART OF A MAMMOTH'S TOOTH RECENTLY UNEARTHED IN TEXAS.

pearance of the supposed stone. Its surface was grooved in regular lines, and on the side were a number of conical indentations. By the merest chance, a scientist happened to see the fragments, and made a minute examination, with the result that the object was found to be the tooth of a mammoth of unusual size.

It was taken away and carefully measured and weighed. An idea of the enormous size of the animal from which it came, can be realized when it is stated that the tooth itself is no less than a foot in length and six inches across the broadest portion. Its total weight is within a

few ounces of twelve pounds. In the opinion of experts who have examined it, the tooth has been embedded for many centuries, and much of the roughness of its surface is due to the corroding action of time. A diligent search has been made for other remains of the great animal, but thus far only this part has been found.



New Lining for Refrigerator Cars

A NEW LINING ("Arctic" brand of Keystone Hair Insulator), especially for refrigerator-car insulation, has recently been placed on the market. Its distinctive characteristic is, that while it possesses the insulating properties of hair felt, it combines the papers used in connection therewith, so that, instead of involving three operations, the "Arctic" can be applied in one. It consists of regular felting hair fastened to and enclosed by two layers of waterproof paper. Tests are said to have demonstrated it to be equal to hair felt, and superior to anything else.

It is furnished in lengths sufficient to reach around a car, and wide enough to extend from the sill to the roof plate. This does away with joints. Car builders will appreciate this saving in labor and waste.

For the floors and roofs, the "Arctic" is furnished according to specifications, to fit the nailing strips and car-lines respectively. It is made from $\frac{3}{8}$ inch to $\frac{3}{4}$ inch thick, according to the quantity of hair employed, and should meet with ready favor.

The H. W. Johns-Manville Company, 100 William Street, New York, are prepared to figure upon specifications and to

furnish samples, data of tests, etc., promptly upon request.

Improved Dyeing Machine

A RECENT INVENTION in machinery used in the dyeing of fabrics, cannot fail to interest a great industry in the United States, so pronounced are its advantages over the present system. The inventor is Mr. Carl Gruschwitz, of Zittau; and the invention applies to that part of dyeing machinery called the "jigger," through which the goods pass at full width in the process of dyeing. The difference from the present method is that the dye is mixed in the vat itself, thereby doing away with the upper construction of reservoirs for that purpose in the present system. The dye is then distributed with force against the cloth by atomizers, instead of the goods passing through a body of liquid.

A Freak Fire Effect

THE USE of miniature savings banks has become so extensive that they are now manufactured in a very substantial manner, many of them being composed of heavy steel. The one shown in the accompanying picture is made of this metal, and recently passed through an ordeal which shows that these little banks can withstand very high temperatures. It was locked up in a safe in a building which was completely destroyed by the recent fire in Baltimore. The safe itself lay among burning embers and hot ashes for three days before it was taken out of the ruins. After it had been cooled and the doors opened, it was found that the heat had blistered the outside of the little bank, peeling off the enamel in places, and discoloring the surface. The lock, however, was uninjured; and when the bank was opened, the pennies and nickels it contained were found to be in as good condition as when placed in it.

The most remarkable feature of it all, however, was a freak of the fire. Attached to the bank was a circular tag made of stiff paper, containing its number and the name of the owner of the coin it contained. Although, as already stated, the heat was so great that the outside of the bank was badly damaged,

the paper tag was not even burned through, while, in places, the white surface was not discolored, as is shown by the accompanying photograph. Near the center the surface of the tag was somewhat charred, but this was actually the extent of the damage. The safe contained a number of paper documents, which were almost entirely destroyed by



MINIATURE SAVINGS BANK.
Showing Peculiar Effects of Fire.

the heat; and why the tag did not burn is a mystery.

Apparently the heat was of sufficient intensity to reduce the paper contents of the safe to ashes; but for some unknown reason the paper attachments of the little bank were injured only to the extent described.

The Traveling Stairway

IT IS NO LONGER NECESSARY to climb stairways or to take the ordinary elevator in going from one floor to another. The moving staircase is an invention now in use in many large stores and other buildings. It is really an inclined floor, moving upon a series of small wheels, which, in turn, are operated by larger ones that might be called driving wheels. The surface of the moving floor fits to the surface of the horizontal floor so closely that there is no danger of a person catching his feet between the movable and stationary sections. Any one who wishes to go from the ground story to the one above, simply walks

upon the incline, and, in less than a minute, is carried to his destination. He may remain still on the incline, or walk along it as he pleases. The motion is so uniform that there is no vibration or jarring; and so rapidly do the stairs operate that one of the devices in New York City will carry 2,000 passengers in an hour to a height of about twenty feet.

The driving wheels, around which the endless floor moves, are usually connected by belting to an electric motor or steam engine. About $2\frac{1}{2}$ horse-power are required to carry 600 passengers an hour;



TRAVELING STAIRWAY.

and double this amount to carry 2,000 passengers. Calculations based on actual experience show that by the use of electric motors, it costs but seven cents to carry 1,000 people per hour.

Sawing by Compressed Air

A NEW INVENTION which has recently appeared in the West, introduces the use of compressed air for operating a saw. This appliance, known as the "Redfield pneumatic engine and frame," is adapted for operating drag saws, for cutting logs, cord wood, heavy timber, and for general use in timber and log camps, displacing the hand-power equipment.

Compressed air to operate the engine and saw can be obtained by using a compressor driven by steam, belt, gasoline, or electricity, or by using an ordinary locomotive air pump attached to the boiler of any logging or portable engine.

The pneumatic engine is capable of making from 125 to 150 strokes per minute, depending upon the pressure of air used. At 60 pounds' pressure it will develop $2\frac{1}{2}$ horse-power. The engine, constructed almost entirely of brass and steel tubing, weighs 50 pounds. It is claimed for the valve motion—which is of an entirely new design—that it has no complicated valves or parts to get out of order, and that it is very simple and easy of adjustment. The frame is made of machine steel and wood, and, though light in weight, is strong and durable.

It is claimed by the makers that one man with one of these machines can easily cut ten cords of 2-foot wood per day, or 50,000 feet in logs, reducing the present labor expense at least fifty per cent.

The McCloud River Lumber Company have given the machine a thorough test and it has proved very satisfactory.

The Acousticon

WITH THE HELP of this ingenious device—the invention of Mr. Miller R. Hutchison, of New York City—it is claimed that any deaf person, save one whose auditory nerve is paralyzed, can be made to hear. Fortunately, even among deaf mutes, there are comparatively few who are absolutely shut out from the reach—at least of some faint echo—of sound waves from the outer world. Deafness is in many cases only partial, being due to lack of, or defectiveness in, subsidiary parts of the ear mechanism, while the essential parts may be present in perfect working order. In such cases, what is needed is not an instrument that will merely amplify sounds, but one that will do the work of the missing or defective organic parts. It is on this principle that the "acousticon" is based. The instrument performs the function of the middle ear. In this air-filled cavity, as every student of physiology knows, are located the "ossicles"—

three small bones constituting a chain or bridge connecting the inner with the outer ear, and over which are transmitted to the fluid-surrounded extremities of the auditory nerve within the inner ear the vibrations caused by the sound waves as they roll in from the outer air and dash themselves up against the tympanum or ear drum. This chamber, owing to its being connected with the nasal passage through the Eustachian tube, is the portion of the ear most liable to affection by catarrh and other disorders, and hence the portion most often directly concerned in cases of deafness.

The acousticon may be described as a combined telephone and microphone. Its essential feature is a cup-shaped body, into the open end of which the sound waves enter, the inner end of the cup

vided, in which both mouthpiece and ear-piece are equipped with a nosepiece for gathering nasal sounds.

A special modification of the acousticon is a portable outfit for collecting



PORTABLE ACOUSTICON, NO. 1.



ACOUSTICON OPERA OUTFIT IN USE.

reflecting and concentrating them upon a vibrating diaphragm. A small but powerful storage battery, capable of being carried in the pocket, is part of the mechanism; and it is claimed that there is no interference of reflected sound waves, such as often gives trouble in the case of ear tubes, trumpets, and horns. The articulation of words is made most distinct, so that even a faint whisper is heard by the deaf mute.

In order to enable the deaf person to eliminate from his attention certain sounds, and to concentrate his mind upon others, a special instruction outfit is pro-

sounds in concert halls and theaters. The opera outfit consists of a double sound-receiving instrument contained within a small box. With the aid of this device, a young woman of twenty-two, who had lost sight and hearing at the age of six years, was able to enjoy the music at an opera in New York City, just as if she had never been deprived of any of her faculties.

A special desk outfit is also manufactured.

Typewriting by Electricity

WILLIAM E. ROBERTS, of Newark, N. J., has invented a way to operate a typewriter by means of electricity. It has always been necessary to depress the keys of a machine sufficiently to throw the type-bar against the inking ribbon and leave its impression on the paper, this action releasing a universal bar, which allows the carriage to move forward one space as each letter is printed. This can now be done by the aid of the electric current. Each rod is connected with a little electro-magnet, and, as soon as the current enters any coil, its corresponding rod is thrown for-

ward, just far enough to hook the lower end of it beneath the edge of the central disc. Just as this connection is made, the passage of the electric current through another electro-magnet depresses the disc, pulling the rod down, and striking the type-face on the paper as though it were done by the depression of a key with the finger.

To form the connection between the individual magnets and the operating mechanism, the writer wears a set of metallic thimbles on the finger, which are wired to the source of the electric current. The instant connection is made with one of the metallic plates on the keyboard, the current passes through the plate into the corresponding magnet, and thence to the disc in the center of the machine.

Fifth Wheel Wagon-Gear

THEODORE SANDSTROM, of Connersville, Indiana, has invented a wagon-gearing with two fifth-wheels, permitting very short turns of the vehicle, and preventing it from being overturned in case of a runaway or accident. One of these is in the usual place on the front axle; and the other is on the rear axle, with a tooth-gear connection, so that when the front wheels are turned, the rear ones will be inclined in the opposite direction.

New Theory of Tides

MR. FREDERICK BROWNLIE, in the Bulletin of the American Geographical Society, discredits the part assigned to the moon as a "tide lifter." He argues that the tide is instantaneous over many degrees of longitude, while the moon takes hours to travel the same distance. The new theory relies upon gravitation to unlock the tidal mystery. It is contended that the form of equilibrium can never be attained by the ocean; that tides are due to different levels in contiguous masses of water, one mass standing at high level immediately contiguous to another at low level. It is well known, for example, that when the tide is high in a vast area around the

Bermudas, extending clear to our coasts, it is low in the waters of Greenland and the West Indies. The theory is that when the tide is high in this large Bermuda basin, its higher waters must gravitate toward the contiguous lower waters. In like manner, when the tide is high in the Greenland and West Indies basins, it is low in the Bermuda basin, and their high waters gravitate simultaneously toward Bermuda's low level; thus high levels and low levels on the ocean surface constantly succeed one another, and the tidal phenomena are produced.

Spider Disables Fire-Alarm System

THE ENTIRE FIRE-ALARM SYSTEM of Bayonne, N. J., was recently disabled by a single spider. The insect was found in the transmitter room, where all the wires converge into a network. Henry D. Kernaghan, who has charge of the alarm system, made the discovery. He said:

"Late at night one tap was struck. I got out of bed and went all over the five circuits, but failed to find the cause of the trouble. The system was plainly out of order, and I was at a loss to know why. I finally turned my attention to the inside, and found every indicator in the department in perfect running order. I went to the City Hall and looked into the battery room. Tests proved everything O. K. there. I then went to the transmitter room and looked carefully over every part. To my astonishment the cause of all my trouble lay before me. It was nothing more nor less than a big, black, hairy spider. It was dead and hanging to the wires in such a manner that its body short-circuited the whole system. The blamed thing had evidently mistaken the network of wires for a new sort of web, and was killed while doing a tight-wire act over it."

Great Salt Lake Disappearing

GREAT SALT LAKE, America's mysterious Dead Sea, will in the relatively near future be only a memory. The rapidity with which this strange body of water is disappearing furnishes a new theme for students of geology. Nothing like it has ever been known before, except in the case of sudden and violent seismic disturbances. Physical transformations of the earth's surface generally require many centuries to show

discernible evidence of the change. This one in western America may change the geographies that the next generation will study. Twenty-five years is by some estimated as the time within which the lake will have vanished. This calculation is based on the cubic contents of the lake at the present time as compared with 1886, when the first adequate measurements on which to base an estimate were made.

An examination of the surface level of the lake has shown a net fall of $11\frac{1}{2}$ feet in the last sixteen years, and of three feet in the last three years. The deepest part of Great Salt Lake contains only 40 feet of water. At the present rate of fall of one foot a year, the lake is bound to be dry within forty years at the outside. But statistics show that the rate of fall is rapidly increasing, and of course the lake grows narrower as the water diminishes.

To Brigham Young may be traced the responsibility for the prospective loss of one of America's strangest wonders. He was the first irrigator in the West, and irrigation has worked the doom of Great Salt Lake. The drawing off of the waters was begun by Brigham Young in the forties. In 1880 the work he had begun was extended on a large scale, and, with its increased importance, the lowering of the lake level was most rapid.

Extermination of Mosquitoes in Panama

THE LARGEST ORDER for mosquito netting ever given is soon to be made by the Panama Canal Commission on the recommendation of General Davis, Governor-General of the American Panama Canal zone, as a means of protecting the houses and hospitals in the district from the disease-spreading insect. The order calls for 100,000 yards of wire gauze. This is to be used to shut out the mosquito, where possible, while the breeding places are being destroyed so as to exterminate the pests. Mosquito brigades are to be organized in the canal villages under the direction of Colonel Gorgas. The object of the work, which is based on the success at Havana, is to free the native population from malarial infection. Screened hospitals will

be made from the wire gauze; and in these the victims of the malarial mosquito will be confined, and kept under constant treatment until the malarial parasite is removed from the blood. Then malarial mosquitoes, being unable to bite anybody previously infected, will become harmless.

Photo by Nature's Flashlight

A REMARKABLE PHOTOGRAPH taken by lightning has been obtained by a Japanese boy in San Francisco. The picture is regarded as an exceptional curiosity on the Pacific coast, where flashes of lightning are extremely rare and thunder is seldom heard. The view



BY NATURE'S OWN FLASHLIGHT.

Photograph of Cliff House, San Francisco, Cal., taken during electric storm at midnight.

is of the Cliff House, the imposing structure which stands sentinel over the Golden Gate. The lightning here served the purpose of a flashlight, only to far better advantage. The photographer stood with his camera open while the storm raged, and during a vivid flash of lightning at midnight this picture was obtained. He waited hours for the chance, but his patience was rewarded with marvelous results.

The Screw-Driver's Successor

THE SCREW-DRIVER, one of the oldest of tools, whose place it has been thought impossible ever to fill, has met a very formidable rival that may more or less completely supplant it in use

as a mechanical implement. Its threatened successor is a simple little instrument called the "Holdfast." Making its debut on the market but a short time ago,

and the screw is held as tightly as in a vise (Fig. 2).

Hard wood offers little opposition to the screw driven with the holdfast. There



Fig. 1.

the "holdfast" sprang into instantaneous popularity, and already has found a place in most modern tool-chests.

The holdfast has one great advantage over the old-time screw-driver in that it

is no danger of cracking the head of the screw, as is frequently the case when it is driven by a hammer. The jaws and case of the holdfast can be removed in a second, when desired, by pressing the



Fig. 2.

will start and drive a screw without the aid of a hammer or gimlet. The complete tool, with the case and jaws set on the blade ready for use, is shown in Fig. 1. When the screw is placed on the blade, the operator loosens the jaws with a small thumb eccentric, pushes the case down and grips the jaws on the screw head. Then he tightens the eccentric

jaws together and pulling out the blade. The tool may be used in a brace or spiral by driving the pin from the ferrule and removing the blade from the handle. Another advantage of the instrument is that by means of it a screw can readily be removed even when it has but half a head. The holdfast is light and strong, being made of the best oil-tempered tool steel.



Dinner-Pail Philosophy

☐ There is plenty of room at the top, but the elevator is not running.

☐ Successful men know when not to tempt failure.

☐ Only a doctor or a dentist can repair some typewriters.

☐ The ice man and the coal man both swear by the thermometer.

☐ Bucket shops are places where men exchange their barrels for bungleholes.

☐ At fifty a man has forgotten about half the things he knew at twenty.

☐ Publishers want original matter, but they draw the line at that brand of spelling.

☐ If a man doesn't break anything else when he slips on a banana peel, he is pretty sure to break one of the commandments.

☐ Just when the undertaker gets ready to give a man the earth, he doesn't want it.

☐ Every new invention is expected to revolutionize things—but it doesn't.

☐ About the time a man thinks he knows a woman, he discovers that he doesn't.

☐ All the world's a circus ring, and each of us at times enacts the rôle of clown.

☐ It's a smart baby that understands the baby talk its mother indulges in.

☐ There are a number of civil engineers in Chicago—also a number who are not.

☐ The I-told-you-so chap is always on hand when the unexpected happens.

☐ Some men get there because they are pushers and some others because they are kickers.

City-Owned Street Cars

Results of a Municipal Experiment in an English City

A RECENT REPORT of United States Consul Hamon, Hull, England, on the subject of municipal street railway service in that city, is fraught with lessons of great practical importance.

The City of Hull, says Consul Hamon, began the municipalization of its transit system at an unusually favorable time. The charters of the old companies were about to expire, so there were few rights and privileges to be acquired. The total outlay of money for this purpose was about \$170,000. At the same date the city was entering upon an extended system of street improvements. The streets were to be repaved and widened, and new avenues cut through the old part. It was thus possible to lay new tracks at the same time that new pavements were put down.

A statement of the street-car system would not be complete without a description of these city pavements. They are of the most enduring character, and afford a foundation for the rails unequalled by anything of the kind that I know of in the United States. First a layer of chalk is put down, ten inches thick. Over this is placed an 8-inch layer of broken stone and cement, in which the ties for the stringers are laid; and on this layer of cement are superimposed the blocks of wood or stone which form the pavement. The rails are of the center-groove girder pattern, weighing 96 pounds to the yard. This forms a track which for solidity and evenness cannot be surpassed. Hull has now a little over 12 miles of such double track, and this number is being constantly added to.

One of the chief peculiarities of the Hull tram system is the double-decked car. Recent statistics show that of the 6,660 electric cars in use in the United Kingdom, 90 per cent are double-deckers, and only 10 per cent single-deckers. In this way the seating capacity of the cars is more than doubled, the upper deck

accommodating more passengers than the lower deck. The Hull cars are of two different dimensions, the smaller seating 22 passengers below and 35 on top. This, of course, compels a heavier style of car and longer platforms, both at the front and rear, so as to prevent congestion in loading and unloading. These cars cost here about \$3,000 each, without the cover over the roof, which is now being added to most of them.

It is often asked why the double-decker has never been adopted in the United States. Two or three reasons



DOUBLE-DECKED TROLLEY CAR.

have been given for this neglect. One is the supposed confusion and delay caused on the platforms by passengers boarding or alighting from the car, part of whom enter or emerge from the interior and part from the upper deck. No such confusion, congestion, or delay is noticeable on the cars in Hull, even during the most busy hours of the day.

The second objection to the double-decker is that it is not adapted to the extremes of climate in the United States. In the heat of summer, it is argued, the passengers would be exposed to the burning rays of the sun; in the winter, to the cold blasts; and at all seasons, to storms. This objection is apparently more tenable than the one based on alleged delay in loading and unloading. But it has been

overcome by the roofing-in of the upper deck with combined glass and wood covers. These protect the passengers from the weather as effectually as the inside passengers are protected. The roofs are of different styles and arrangements. They all have a fixed wooden framework, but in one pattern the side windows can be raised or lowered separately, while in the other pattern all the windows on both sides of the upper deck are raised and lowered together by a winch. The roof in both styles coils up like a roller-top desk, either in sections or all together. In one style of these the deck extends completely over both platforms; but in the kind used in Hull, it is only

hours of the day. So this third objection to the double-decker vanishes.

One of the chief merits of the double-decker car is that it offers a smoking compartment for men with every car. Very few women climb the stairs, although they are easy of ascent and descent; and accidents from falling are so rare as to make them a negligible quantity. The "deck" is especially popular with men, who can smoke as they will even if women are present, the free circulation of air removing all offensive odors. Another merit of the double-decker is its uses as an observation car, the pleasure of riding so far above the street with an extended outlook being great.



DOUBLE-DECKED TROLLEY CAR, WITH UPPER DECK ROOFED IN.

a little longer than the body of the car. This inclosing of the upper deck would appear to overcome the climatic objection to this kind of car.

A third objection to the double-decker is the added weight and difficulty of handling them. How decisive this objection would be on roads in cities where there are heavy grades, I do not know; but on level grades, no difficulty is experienced. The cars are stopped and started as quickly and easily as the single-decker cars; and there are more slippery tracks to contend with in this country than in the United States, the fogs and rains causing wet and muddy rails much more frequently. The weight of these double-decked cars, with every seat occupied above and below, cannot be much more than the weight of the crowded single-deck cars run on nearly every American street railway during the busy

Next to the style of cars, the chief distinguishing feature of the Hull tramway system, is the cheapness of the fares. These are 1 penny (2 cents) on all lines and for all distances. The financial results of this low-fare system are equally interesting. During the last twelve months reported on, there were 10 miles of double track, or 20 miles of single track, in operation. The gross income was about \$445,000; the cost of operation was about \$233,000; this left a gross profit of \$212,000, and, deducting interest on the investment and the sinking sum, left a net profit of \$122,000, or an average of over \$12,000 a mile of double track, which went into the City Treasury.

The wages paid look low to an American. Motormen receive from \$6.75 to \$8.50 a week, and conductors from \$5.00 to \$6.50 a week. But it must be remembered that house rents and some kinds of provisions are lower in England than in most American cities. This difference might make it necessary to add \$2.00 a week to the wages of Hull motormen and conductors when comparing them with the wages of the same class of American workingmen. But, as the total wages paid on the whole system was a little less than the net profits, after deducting interest and sinking fund, it is evident that wages could be doubled and still a small profit be shown. All the employees are of an excellent class, fully equal in intelligence and efficiency to those employed on any street-car line. A day's work consists of ten hours, the cars being

run from 5 A. M. to 11:30 P. M. The speed varies in different parts of the city, the maximum being 12 miles an hour. The overhead trolley is used.

These are the results of the municipalization of city transit in Hull. They give American cities a striking proof of the mistake they have made in surrendering

their streets to private companies that operate the lines for their private benefit, and often to the detriment of the public. If the advocates of the municipalization of street-car lines in the United States wish a good object-lesson on their side of the question, they cannot do better than to study the Hull tramway system.



Locomotive Whistle Signals

Just one long blast on the whistle, ——— this style,

Is a sign of nearing town,

A railway crossing or junction, maybe;

And this —, the brakes whistled down.

Two long ——— are just the reverse of the last;

And this ——— the engine's reply,

When word comes from the conductor to stop,

A sort of cheerful Ay! Ay!

These three ——— will show when the train comes apart;

This — — — means two different things:

That the train will back, or asks you to note

Some special signal it brings.

These four ——— belong to the flagman alone,

And these ——— are meant for the crew;

But this one ———, when crossing a road at a grade.

More nearly interests you.

Five short ones — — — — — say to a flagman on guard,

"Look out for a rear attack!"

And a lot like this — — — — —, that a heedless cow

Or a deaf man's on the track!





THE NEW YORK CENTRAL RAILROAD is now having built thirty electric locomotives which are expected to haul trains of cars at a speed of 75 miles an hour. These locomotives will be capable of developing 2,800 horse-power. The present steam locomotives which haul the Empire State Express have a horse-power of 1,500 when running at 60 miles an hour. The weight of one of these electric locomotives is 85 tons; and the length, 37 feet. The diameter of the driving wheels is 44 inches; and of the pony truck wheels, 36 inches. The New York Central has made the first step among the railroads towards the replacing of steam locomotives with electric.

HAS THE REMARKABLE DEVELOPMENT of interurban trolley lines detracted from Trolley or added to the business versus Steam of railroads? Instead of Lines looking on these electric lines as competitors, big railway systems are now beginning to regard them as "feeders" to the main lines. Statistics show that in short hauls the electric lines detract considerably from railway passenger traffic in localities where there is much competition, but it is believed that in long hauls they have added greatly to the business of the railroads by creating a desire for traveling, and by making the main lines easily accessible from points whence they derived little patronage before the advent of the interurban trolley lines.

In 1895—the year when the independent railway systems of cities began to expand into "interurban" lines, connecting towns and cities over wide stretches of country—the Lake Shore & Michigan Southern road carried 104,426 west-

bound and 98,588 east-bound passengers between Cleveland and Oberlin, Ohio, a distance of 34 miles. In 1896 the network of trolley lines about Cleveland was practically completed. By 1902 the trolley lines had made such inroads upon the business of the railway lines that the latter carried a total of only 91,761 passengers between Cleveland and Oberlin, against a total of 203,014 seven years before.

On the 29 miles of track between Cleveland and Painesville and intermediate points, the Lake Shore carried a total of 199,292 passengers, or an average of 16,608 a month, in 1895; and 28,708, or an average of 2,302 a month, in 1902.

Prior to the building of the electric road from Detroit to Ann Arbor, Michigan, a distance of 40 miles, the purely local business of the Michigan Central road between those points was about 200 passengers a day. During the first summer that it was in operation, the electric road averaged 4,000 passengers a day between those points.

Undoubtedly a great amount of entirely new traffic has been created by the electric lines. The steam roads, it is believed, have derived great advantages from this new business, as statistics show a great increase in long-haul traffic from all districts where the interurban trolley has reached a high stage of development.

ONE OF THE QUEEREST SHIPMENTS of Kansas products that has been sent from Shipping Soil Emporia for a long time, from Kansas was a two-bushel sack full to Indiana of rich Lyon county earth from Will Williamson's farm, four miles west of Emporia, which was sent to a man in Indiana. The Indianian also secured some Kansas alfalfa seed, and will

experiment with that crop. The alfalfa earth is impregnated with a kind of parasite which lives on this plant; and this is a very good thing for the alfalfa, because the plant flourishes on dead parasites. The transported soil will be scattered over the field in which the seed is planted. The experiment will be watched with interest.

PROBABLY as simple and clear an explanation of the manner in which gold coin circulates through the commercial world, was given by one of our weeklies in the following editorial:

How
Gold
Travels

Some coined gold recently made an interesting journey from Tokio to Paris, by way of the United States, and is now on its way toward St. Petersburg.

Japan has been buying supplies heavily from the United States. Such transactions can ordinarily be settled through bills of exchange, by which purchases and sales on one side of the water are swapped off against purchases and sales on the other. But, because of war needs, Japan bought much more than usual in this country. The "balance of trade" between the two countries turned strongly in our favor, and Japan had to send gold across the Pacific to square the account.

Meanwhile the Government of the United States has bought for forty million dollars the property of the Panama Canal Company, which was owned chiefly in France. It may be that some of the identical gold that came from Japan was used in the payment for the canal. It would have reached Paris just when the French were taking a great Russian war loan.

So, unless Russia uses the proceeds of its French loan to buy supplies in Paris, or to pay for them from that city, this gold, continuing its journey, may go to St. Petersburg, and come into the possession of the country with which Japan is at war. On the other hand, there may be a return movement to Japan of the gold realized by the Japanese loan, which was mostly taken up in England and the United States.

Gold, instead of other metals or of

paper money, performs these journeys, because it is the article in which international balances are settled. It serves this purpose because its value as coin and its face value are everywhere identical. The coin of one country can be melted into that of another without loss.

Hence gold moves about the world regardless of the symbols which individual nations may stamp on its face.

ACCORDING TO OUR CONSULAR REPORTS, there has been only 5 per cent increase in our trade with the South American states during the last thirty years.

To the forty million people in South America, our yearly sales amount to less than \$1.00 per capita. This is a most inadequate and unsatisfactory state of affairs. We sold to the Canadians last year a little less than \$24 per capita; and to the Cubans, without any reciprocity, about \$15 per capita. Of the total imports into South American countries, our share is only a fraction more than 10 per cent of their trade; and, while we boast of our American shrewdness and superior methods of business, the unsatisfactory condition of our trade in South America is due mainly to a lack of intelligent and well-directed trade energy. We buy from them three times as much as we sell them. We pay them \$120,000,000 for their products, and they use the difference between that and \$40,000,000 to purchase from our foreign competitors the goods which we might and ought to sell them. In other words, we supply them with funds which enable them to buy from other people things that we grow and manufacture. In the last thirty years, we have purchased from South America \$1,700,000,000 more than we have sold it by direct transportation.

THE ILLINOIS CENTRAL RAILROAD has always shown a wise foresight in matters relating to the future. The clearing of the forests in the Middle West has brought home to the large railroad systems the importance of tree planting,

Railroads
and Forestry

to make sure of a supply of ties in the coming years.

Three years ago at a point near Du Quoin, Ill., the Illinois Central planted 200,000 catalpa trees. This artificial forest is thriving splendidly; and it will not be long before many of the ties on the Illinois Central Railroad will be cut from their own forest, planted in the heart of Illinois. The same company is at work on a similar forest in Mississippi.

GLASS ENGRAVING may become as popular as was brass hammering a few years ago. With the use of a weak acid solution and a set of engravers' tools, truly wonderful work can be produced upon the surface of goblets, tum-

attention to becoming proficient in the art; but expert handiwork can produce many beautiful creations if the designer has an artistic eye. Bright women who have not the means to present their friends with costly cut glass or expensive imported ware, can engrave a set of tumblers or a pitcher of the commonest material, and convert it into a gift which the recipient, if a lover of the beautiful, will thoroughly appreciate.

FOR TWO YEARS, in Washington, D. C., a Naval Board has been experimenting with liquid fuel. The report of its work, recently made public, states that crude petroleum is more of a steam producer than coal, and, with slight dis-



SPECIMENS OF ENGRAVING ON GLASS.

blers, pitchers, and other ordinary utensils. The designs, as will be seen from the accompanying illustration, embrace a variety of patterns—from leaves and flowers to representations of animals, birds, and persons. It is claimed that work of a much finer character can be done than in the case of glass cutting, while very thin ware can be used without danger of breaking. The pioneer glass engraver in the United States was Joseph Locke of Pittsburg, Pa. He learned his trade at Worcester, England, and worked in a number of the most noted factories of Great Britain. He had an exhibition of his work at the Chicago World's Fair in 1893, which first attracted attention to the opportunities for working on glass in this manner.

This industry promises to become very popular, especially with women, as so few tools are required and the work can readily be done at home. One must, however, devote considerable time and

tillation, its combustion is less wearing on boilers. These are two of the conclusions reached by the Board; and they will, without doubt, prove an effective spur to the development and use of oil as a fuel in the sections of country where it is plentiful.

ACCORDING TO THE REPORT of the American Consul-General, there are four **Steel** yards in Canada for the **Shipbuilding** in construction of steel vessels. **Canada** One yard is building a canal boat that is to carry 7,500 bushels of wheat, or 23,000 tons of dead weight. Her cost will be \$130,000. This yard has several other contracts nearing completion. The steel plates used are now imported free of duty from the United States, as they are not made in Canada. As British-built steel vessels come into Canada duty free, it is impossible to de-

velop the industry in Canada successfully, except for vessels of small size or of a design necessitated by local requirements. It is stated that a Nova Scotia steel company intends to manufacture plates; if so, the duty of 25 per cent will attach, and the price likely advance. This would probably cause the suspension of steel shipbuilding in Canada unless sustained by duty or bounty.

THE STEAM TURBINE is making large gains in public favor. The immense

The power station of the Pennsylvania, New York & Long Island Railroad, and the Philadelphia Rapid Transit Subway system of Philadelphia, are being equipped with steam turbines, aggregating at the start 33,000 K. W. capacity. Also, the Interborough Rapid Transit Company of New York and the Brooklyn Rapid Transit system have both adopted steam turbines of the Westinghouse-Parsons type for extensions in power. The equipment of these systems will be in units of 5,500 K. W. each, thus conforming to the precedent established by the Pennsylvania and Philadelphia systems in regard to the capacity of their largest main generating units. The Philadelphia Rapid Transit Company have also recently extended their original order for 16,500 K. W. in Westinghouse-Parsons turbines, by 6,000 K. W., in four units of 1,500 K. W. each. A contract has recently been closed with the Merchants' Light, Heat & Power Company of Indianapolis, Indiana, for two 750-K. W. turbine units for general light and power service. At the Cactus Mines, Utah, turbines furnish electric power for lighting the buildings and mines, and for all other forms of power throughout the company's property.

REAR-ADMIRAL MELVILLE has returned from Europe, where, as representative of the Navy Department, he investigated the present relation of the steam turbine to marine service. The admiral expressed himself in the following words:

"I shall oppose the building of warships with turbines, except for experimental purposes. The whole thing is in its infancy, and there is not an engineer living who is willing to swear by it. In London I had many interviews with Lord Selborne, First Lord of the Admiralty; Rear-Admiral Sir John Durston; Admirals May and Oram; Sir William H. White, the naval architect; and with members of the Cunard Commission, appointed to study the turbine. The Cunard people were not very communicative, being pledged to secrecy; but the naval officials gave me much information. I visited yards in the United Kingdom where turbines are building, and saw five of the vessels in process of construction. These boats were of moderate speed, of the triple-screw type. I found no one who was satisfied with the claim of economy of coal and weight made in behalf of the turbine. As to space, there seemed to be no question in the minds of the shipbuilders; and, while all are anxious to build, none are ready to guarantee anything but moderate speed, and I am surprised that the Cunard Line should make an experiment on such a large and expensive scale. In my visits to foreign shipyards I went to Stettin, Hamburg, Flushing, and through some French yards. I found the French yards dabbling in the turbine to a small extent only. Of all the engines that I examined, I found the Westinghouse 'double-flow' the best."

MORE THAN 50,000,000 POUNDS of India rubber, valued at over \$30,000,000,

India were imported into the United States last year.

Rubber In 1890 the quantity was only 33,000,000 pounds; in 1880, 16,000,000 pounds; in 1870, 9,000,000 pounds; and in 1882, the earliest date at which rubber was shown in the import statistics, it was only 2,125,516 pounds.

This rapid growth in the importation of crude India rubber is, of course, due to the great increase in its use in manufacturing—for rubber garments, shoes, etc., and its use in machinery and as tires for vehicles. Over \$100,000,000 worth of manufactures from India rubber is now turned out from the factories of this country every year, and about half of this total is in the form of boots and shoes.

So great is the demand for India rubber for use in manufacturing, that not only has the importation vastly increased, but, in addition to this, the forests of the East Indies are called upon for several million pounds each year of a new substitute for gutta percha, known as "gutta

joolatong;" while the highways and byways of Europe and other parts of the world are also ransacked for cast-off rubber, from which rubber is "reclaimed" to be used in conjunction with new rubber from the forests of Brazil, Africa, and the East Indies.

A STATEMENT issued by the Bureau of Statistics of the Department of Commerce and Labor shows **Japanese Imports of Electrical Machinery** that the exports of electrical machinery to Japan for the eleven months ended May 31, 1904, were valued at \$715,057, as compared with \$426,562 for the corresponding period of last year. The exports of scientific instruments for the same periods decreased from \$255,833 in 1903 to \$131,605 in 1904. Increases are shown in other articles—cars and carriages, from \$133,402 to \$250,446; builders' hardware, from \$129,449 to \$148,133; locomotives, from \$275,042 to \$499,073; typewriters, from \$14,357 to \$21,042; and a substantial increase in most other articles is noted. The war has not thus far had any appreciable effect on Japan's demand for modern things.

THE *Electrical Review* contains the following interesting item:

"Our foreign exchanges report that at one of the meetings of the South African Lighting Association, to account **Reduction of Municipal Expense** for the shrinkage in the consumption of gas, it was explained that the Government of Cape Colony has adopted a standard time which moved forward the day one hour. Now, the people of South Africa regulated their daily affairs by the clock before this change, and they still do so. They rise one hour earlier and go to bed accordingly. This shifting forward of the day in effect extends twilight into the night. Street lamps are lit an hour later—according to the clock—and, as they are extinguished at the regular time, an hour of lighting is saved. It does not appear that the new life is less enjoyed than the old, as doubtless the chickens, cats, and other domestic animals have also adopted the new day. This is surely an exceedingly simple and effective method of reducing one item of municipal expense; and we recommend it to those towns which, owning municipal plants, each year have the hard problem of making the income meet the expenses."

ACCORDING to the United States Census Bureau, the telephone industry in the United States represents a capital of over **The Telephone Industry** \$450,000,000, covering slightly over 4,000 systems, with 2,371,044 telephones of all kinds, over which were exchanged during the year 1902 the extraordinary number of more than 5,000,000,000 telephone conversations. This industry employed 64,628 wage-earners, to whom was paid \$26,369,735; and 14,124 salaried officials and clerks, who received \$9,885,886. The revenue derived from the industry reached the immense total of \$86,825,536. The expenses for the year were \$61,152,823. The interest on bonds was \$3,411,948, and the dividends paid were \$14,982,719. It would appear that, exclusive of the interest on bonds, the expenses were just about 70 per cent of the income.

THE DEMAND for motors and all other electrical apparatus, in Scotland, is steadily increasing; and American companies prepared **Profitable Field for Electrical Eng'ing Firms** to compete in these lines of manufacture have now their best opportunity. The application of electricity as a motive power in various industries—for urban lighting and traction, as light and power for coal mines, and for other uses, examples of which are numerous, mark the real dawn of the electric-power era in this part of Great Britain. American manufacturers have in the past few years furnished some of the heavy machinery for municipal generating stations and private plants, and also a considerable number of dynamos, motors, etc. American-English concerns have done much in this line—in fact, they seem to be well ahead of all others.

A CAPE-TO-CAIRO RAILWAY is becoming a reality far more rapidly than any **Cecil Rhodes's Dream** one would believe possible at the time the scheme was first broached by the late Cecil Rhodes. Last week a train left Cape Town for Victoria Falls, a distance of something like 1,600 miles.

From Cairo the railroad now penetrates far into the Soudan. Roughly speaking, two-thirds of the "Cape-to-Cairo" line is already completed; and in a few more years Africa will be traversed from one end to the other by rail. A railway trip through equatorial Africa does not appear to offer any advantages over transportation by the Southampton liners; but, as a commercial undertaking, the road will be of the greatest importance in opening up the resources of Central Africa. Its strategical and political importance to the British Empire, as another link of intra-imperial communication, goes, of course, without saying.

THE GOVERNMENT of Algeria contemplates giving subsidies to Algerian farmers for the purchase of plows of modern construction. The governor-general of that French African province has publicly called the attention of the natives to the advantages to be derived from using modern plows instead of the antiquated implements now in vogue there.

The Egyptian Government has granted \$8,500,000 in aid of the construction of a line of railroad from Berber to Suakin.

The town of Pardubitz, Bohemia (Austrian Empire), is about to construct waterworks.

The commercial agent of Canada, representing the Dominion's trade interests in Australia, reports that the towns and settlements of Tasmania, Victoria, and South and West Australia are rapidly introducing calcium carbide lighting plants and implements.

A branch railroad is to be constructed between Alberdi and Sudbesta in Argentina.

The breweries at Pilsen, Bohemia, will erect a large electric central station to furnish that noted industry with power.

The Russian Ministry of Roads and Traffic has decided to operate a branch of the Baltic Railway by electric power.

The municipality of Venice, Italy, has resolved to purchase electric-motor boats.

The waterworks of San Juan, Argen-

tina, are to be extended, at a cost of \$338,167.

The value of artificial and chemical fertilizers annually used in Italy is estimated at \$8,250,000, among which mineral superphosphate, Thomas slag, Chile saltpeter, and ammonia sulphate are the principal items.

Owing to great losses of cattle by the rinderpest in Egypt, the large plantations and farmers there are about to introduce steam plows and automobile machines for the cultivation of grain and cotton.

THE CAPE-TO-CAIRO RAILROAD is soon to have the highest bridge in the world.

A huge one-span arch steel bridge—the main span 500 feet—is to carry the road across the Zambesi river, a short distance below the Victoria falls.

The material for the construction will be transported across the river from one bank to the other by means of an electric cableway.

IN HOLLAND AND BELGIUM the dog occupies the place which the donkey does in several other countries.

Dutch Draught Dogs In the former, the sight of a couple of dogs dragging along a pushcart loaded with vegetables, flowers, or shining milk-cans is a familiar one. The dogs trot along underneath the cart, within easy reach of the blunt toe of the sabot worn by the woman who walks behind to guide the cart by the handles attached at the rear. In Belgium the dogs are hitched in front, three abreast, and are guided by a pair of rope reins fastened to a muzzle about the nose of the middle dog. Recently the National Cart Dog Association held its first exhibition of cart dogs. The Flemish breeders have found that, in crossing Belgium mastiffs with Great Danes, with the idea of increasing the size of cart dogs, and so securing additional strength, they made a mistake. The result proved to be animals with weak hind quarters and disproportionate limbs. Now the breeders are endeavoring to revive the original stock.



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PRESIDENT ROOSEVELT.

Practical Talks by Practical Men

The Strenuous Life

By THEODORE ROOSEVELT

President of the United States

A LIFE OF IGNOBLE EASE, a life of that peace which springs merely from lack either of desire or of power to strive after great things, is as little worthy of a nation as of an individual. I ask only that what every self-respecting American man demands from himself, and from his sons, shall be demanded of the American nation as a whole. Who among you would teach your boys that ease, that peace is to be the first consideration in your eyes

—to be the ultimate goal after which they strive?

* * * You work yourselves, and you bring up your sons to work. If you are rich, and are worthy your salt, you will teach your sons that though they may have leisure, it is not to be spent in idleness; for wisely used leisure merely means that those who possess it, being free from the necessity of working for their livelihood, are all the more bound to carry on some kind of non-remuner-

ative work in science, in letters, in art, in exploration, in historical research—work of the type we most need in this country, the successful carrying out of which reflects most honor upon the nation.

We do not admire the man of timid peace. We admire the man who embodies victorious effort; the man who

never wrongs his neighbor; who is prompt to help a friend; but who has those virile qualities necessary to win in the stern strife of actual life. It is hard to fail; but it is worse never to have tried to succeed. In this life we get nothing save by effort. Freedom from effort in the present merely means that there has been stored up effort in the past.



Science and Art

OLD ALEXANDER, the porter of the Royal Institution in London, was quite a distinguished character in his way, and from his long experience was on terms of more than ordinary familiarity with the professors and visitors. One day he was assisting Professor Huxley to hang the diagrams for his lecture. The screen on which the diagrams were hung was not very large, and Huxley, do as he would, could not succeed without the blank corner of one diagram overlapping the illustration of another one on which he placed great importance. What was to be done? The professor asked Alexander to bring a pair of scissors. The scissors were brought; but, as the joint was somewhat loose the professor was not able to cut the paper, and he threw the scissors down in disgust, adding that they were useless. "Vera guid shears, Professor," said Alexander. "I tell you they won't cut," said Huxley. "Try again," said Alexander. "They will cut."

The professor tried again, and, not succeeding, said somewhat angrily: "Bring me another pair of scissors." Lord (then Sir William) Armstrong stepped for-

ward and ordered Alexander to buy a new pair. "Vera guid scissors, Sir William," persisted Alexander, and, picking up the scissors from the table and placing his thumb and forefinger into the handles, he stepped forward and asked Huxley how he wanted the paper cut. "Cut it there," said Huxley somewhat tartly, at the same time indicating the place with his forefinger.

Alexander took hold of the paper, and, inserting the scissors, pressed the blades together and cut off the required portion as neatly as if he had used a straight-edge; then, turning to the professor with a rather significant leer and twinkle of the eye, said: "Seeance an' airt dinna aye gang thegither, Professor." Huxley and all present collapsed. Huxley put his hand into his pocket, and, taking out a sovereign, gave it to Alexander, adding at the same time. "You have done me." The same evening Alexander related the story with great gusto to a friend. When asked how he dared make so free with such a distinguished man, he replied with great emphasis: "Lord, mon, they bits o' professor bodies ken naething at a' except their buiks."



Underground London

THE AMERICAN TOURIST visiting London for the first time, is almost certain to leave the city, which Englishmen believe is the heart of the world, without knowing that another London, in many respects more wonderful than the one he sees, lies beneath his feet. In this buried city are hundreds of miles of streets; a river fed by a score of streams flows quietly along between its shadowy banks; baths, bakeries, and restaurants carry on their work where daylight never enters, and safely removed from the dust and bustle of the traffic above them. In a certain district are wine vaults, which, if ranged in a line, would extend over thirty miles.

If you doubt the existence of a subterranean London, inquire of some Englishman who has explored this buried city, and he will tell you of clean, well-paved, well-ventilated, well-lighted subways, along which you may walk for hours. At your side run high pipes carrying the electric wires, pneumatic tubes, etc., for the use of the millions of human beings in the London above. In your walk you may stop and look down through a grating on a railway station far beneath you,

and at the same time hear the thunders of an underground train just above your head. Deep down beneath where you stand, are other passages through which run enormous gas and water mains; and between, at different levels, is "the most wonderful network of underground railways in the world." In this buried London are hundreds of miles of sewers, the exploration of which is by no means a pleasant task, as rats are there in thousands. The old Fleet River, about which we read in the doings of bygone centuries, flows to the Thames through a channel over twelve feet in depth, and, after heavy rains, thunders along in great volume. Beneath St. Paul's churchyard is a large, well-equipped restaurant where hundreds take their meals every day. To gain an entrance to this restaurant, you must walk under a large block of warehouses.

While on this subterranean trip, you will be shown many interesting historical relics—for example, an arch and doorway built about the time Pompeii was destroyed, and the bath in which the Roman Emperor Severus took his morning dip seventeen centuries ago.



The Outlook for Trained Men

WHATEVER CRITICISM may be directed against the courses of engineering study given by our American schools, there is no escape from the fact that their graduates now fill a very large proportion of the most important and best paying positions open to engineers. Such a condition cannot result from chance or mere good fortune; on the contrary, it has come about because employers have found it to their advantage to employ such men in preference to others who have not received similar training. As these graduates themselves become employers, they turn naturally to the schools for their assistants, and the next genera-

tion is likely to find the graduate engineers in full control, from highest to lowest.

The technically trained engineer is to-day exerting a mighty influence in the development of the country and its resources, and in the future will perhaps play an even more important part. Our engineering schools may well feel proud of the results of their labor, and he will be foolish, indeed, who, in the light of what their graduates have accomplished and are accomplishing, will say that the training which they have given is far wrong in its conception or its attainment. —Proceedings of the Society for the Promotion of Engineering Education.

Noon Hour Talks

Has "Success" an Age Limit?

ONE OF THE COMMON "SAWS" of to-day is that "this is the age of young men." This phrase we are constantly meeting in the literature put forth by a certain class of magazines, and it has also become a part of the stock in trade of popular lecturers. Analyzed, it is meant to express the belief that in all the active pursuits of life, the young man is in the saddle; that the young man of this age has his hand on the throttle of the world.

Youth Successful in All Ages

And yet young men play no greater, no more prominent part in this generation than they did in others. Luther in the sixteenth century, Newton in the seventeenth, Napoleon and Pitt in the eighteenth, and thousands of others—dating from the present back to Alexander the Great, who conquered the then known world before he was thirty—bear witness that the young man of ability, of initiative, is not the peculiar creation of this generation, but common to all time. In estimating the success of young men in past centuries, we must judge them by the achievements which meant success in their own age, not by what means success in ours.

The secret of success has never been a matter of age. A man may be old or young, and fail. Success depends upon the quality of a man's ability and the steadfastness of his purpose. Men of ability and moral strength have won success at 50 as often as have men of 25. It is simply a question of paying the price. If a man is unwilling to pay in time, skill, patience, the price demanded

to attain a certain end—no matter whether he be twenty-five or seventy, he will fail. The young man who starts out with the idea that in the active affairs of life the old men are on the shelf, makes a mighty big mistake.

What Old Men Have Done

Doctor Johnson wrote his famous "Lives of the Poets" at seventy-eight. Galileo was seventy when he wrote on the "Laws of Motion." Bismarck ruled Germany at seventy-five. General Grant was unknown at forty-two. In the active affairs of the world, it is not a question of *How Old Are You?* but *What Can You Do?* It is true, "A man at fifty is too old to run up and down on the icy top of a freight car in winter;" but as a man with an active, productive brain, he should be at his best. If he has profited by his opportunities, he should be even better off and more useful at sixty than at fifty.

Another Popular Fallacy

It is said that youth is the best time to study. Quite true. In youth the average boy's most important work is to attend school. Under ordinary circumstances there is nothing else for him to do. But the statement that youth is the best time to study does not mean that a grown man is incapable of being a good student. If the truth were told, we should discover that old men are among the best of students. Some people talk as if a man at forty were incapable of mastering a science, art, or trade; that to take up any serious study after thirty-five or forty, is only a waste of time and money. But

listen! Noah Webster mastered seventeen languages after he was fifty. James Watt, the inventor of the Condensing Engine, learned to speak and read German at eighty-seven. George Stephenson did not learn to read and write until he had reached manhood. Richard Baxter did not know a single letter at eighteen. "Men are like wine—age sours the bad and improves the good."

Opportunities for Old and Young

How many times will a mature man say to a younger friend or fellow-worker, "I wish when I was young I had had your opportunities to get an education, and I should have made something of myself." He seldom, if ever, realizes that the same educational opportunity is waiting at his own door. There is a certain excuse for a man of fifty-five or sixty feeling that it is little use at his time of life to start a course of study; but when a man of thirty-five or forty deliberately refuses to enter upon a course of study, the accomplishment of which would be certain to bring him promotion in his trade or profession, such a man commits a positive crime against himself. A large number of the men whose names are associated with some famous invention or industrial development, received their education late in life. We would not for one moment depreciate the educa-

tional advantages of youth; but the man who sets earnestly to work to educate himself in something he knows that he needs, will find such an education of infinitely greater value than two-thirds of the information forced into him in youth.

Ripened Genius

You will be surprised by the reading, more especially of literature, to see the age at which many of the world's great authors put forth their masterpieces. Sophocles was nearly ninety years old when he produced the greatest of Greek dramatic poems, "Antigone." While it is not certain, Dante is thought to have been close on fifty-six when he finished his "mediaeval miracle of song." It was when John Milton, the blind Puritan, was fifty-six that he sat down to write his immortal epic. Wordsworth in his eightieth year was composing noble poems. The older men of this generation are not receiving the credit they deserve for what they are doing. The young men of to-day make such a noise, that the quiet, mature, experienced work of the older men is too often passed without notice; but look deeply into the world's life, and you will find that success has no age limit. The men who in this generation are guiding the world's work, cover a period from young manhood to old age.

"Each petty hand
Can steer a ship becalmed; but he that will
Govern her and carry her to her ends, must
know
His tides, his currents; how to shift his sails:
What she will bear in foul, what in fair
weathers;
What-her springs are, her leaks, and how to
stop them;
What strands, what shelves, what rocks to
threaten her;
The forces and the natures of all winds,
Gusts, storms, and tempests; when her keel
plows hell,
And deck knocks heaven—then to manage her
Becomes the name and office of a pilot."



CONSULTING DEPARTMENT

In order to receive attention, all inquiries must be addressed to the Consulting Department, and must be accompanied with the full name and address of the sender. In view of the fact that the inquiries already received have far exceeded the available space, the Editors reserve the right to select for publication only those inquiries likely to be of greatest interest to the readers of the magazine in general. Other inquiries will be answered by letter.

Compressed Air

Question 1: If air at 32° F. be compressed to 75 pounds (gauge), what will be the temperature at the latter pressure, providing no heat is given or conducted during compression?

Question 2: How many pounds of steam per I. H. P. per hour are consumed by the theoretical engine, the boiler pressure being 100 pounds (absolute) and exhausting into the atmosphere?

Question 3: At what temperature at atmospheric pressure does air become liquid, and how many B. T. U. are given off during liquefaction?—I. A. H.

Answer 1: The temperature of air when compressed with no heat loss, is determined by means of the formula:

$$\frac{T_2}{T_1} = \left(\frac{p_2}{p_1} \right)^{.29}$$

T_1 being the absolute temperature of the intake air, and p_1 being the absolute pressure of the same. T_2 and p_2 are the corresponding final temperature and pressure. From this we see that the final temperature is 370° F.

Answer 2: About 13 pounds is the quantity of steam consumed per horsepower of actual work done per hour. This is on the assumption that there is no back pressure of exhaust or of compression, and that there is no loss of steam by cylinder condensation or leakage. A

clearance of 7 per cent, however, has been assumed.

The above, then, you see, indicates what the possibilities are of steam at 100 pounds' absolute pressure (85 pounds' gauge pressure). If the steam is not allowed to expand, but is taken in at full pressure throughout the entire stroke, the economy is much lower. Under these conditions, about 34 pounds are required per horse-power per hour.

Answer 3: Air has not yet been liquefied at atmospheric pressure. There is a certain "critical" temperature for all gases, above which they cannot be liquefied by pressure alone. This temperature for air is given as — 220° F., and at this temperature it takes about 39 atmospheres to liquefy air. Its latent heat, or the number of B. T. U. given off during its change from a gaseous to a liquid state, is not known with certainty. It is, however, supposed to be about 123 B. T. U.

Explosion of Gasoline Engines

Question: Why do so many gasoline and naphtha engines explode?—J. W. H.

Answer: If the operation of explosive motors have one or several mis-fires, the cylinder becomes overcharged with com-

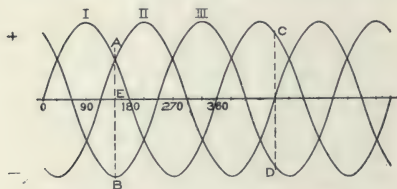
CONSULTING DEPARTMENT—(Continued)

bustible mixture, and the fire is liable to produce an excessive explosion in the motor. The common cause for dangerous explosions, however, is in having fire come in contact with the supply tank through some accident.

Direction and Energy of Polyphase Currents

Question: In what directions, on the three wires of a three-phase high-tension alternating-current system do the currents flow—that is, for three successive alternations? Does each of the three wires carry the same amount of energy as the others at any given instant, or at the maximum current of each alternation?—C. R.

Answer: This matter can best be shown by means of the accompanying sketch, which shows the current curves of



CURRENT CURVES OF 3-PHASE BALANCED SYSTEM.

a three-phase balanced system. Now, the direction and magnitude of current in each one of the three phases may be determined at any given instant by drawing a line such as A B at any point, such as for instance 150° . Let us consider that the current in one direction is positive, as represented by the curves above the line; and in the opposite direction negative, as represented by the curves below the line. Then, at A B, the currents in phases 1 and 2 are in a positive direction and equal, while the current in phase 3 is in the negative direction. Again, at C D, the current in phase 2 is zero, while that in phase 1 is positive and exactly equal to that in phase 3, which is negative. In the same way, by passing lines through the curves, similar to A B and C D, it is possible to investigate the direction and value of currents at any desired point.

The algebraic sum of the ordinates of the three curves is equal to zero at any point. For instance, at C D, the ordinate

of curve 2 is zero, and the ordinates of the other two curves are equal in value, but opposite in sign. At A B, the sum of the two positive ordinates of the curves 1 and 2 is equal to the negative ordinate of curve 3, because $A E = \text{Sine } 30^\circ = \frac{1}{2}$; and $B E = \text{Sine } 90^\circ = 1$.

If the system is balanced, each phase will be carrying the same amount of current at corresponding points in the cycle; but since, from the nature of a three-phase current, the phases are displaced by 120° , these corresponding points are not reached at the same instant, but successively for the three different phases. The above discussion refers to instantaneous values. The virtual or effective current of one phase is the vector sum of the currents in the other two phases.

Operation of Cream Separator

Question: How does a cream separator work?—W. B.

Answer: Centrifugal force is used to separate the cream from the milk. The receptacle for the milk is arranged with a spindle passing through the casing, so that it can be revolved at the rate of from 1,000 to 1,500 revolutions per minute. The centrifugal force throws the heavier milk near the outer part of the receptacle, where it is drawn off through a pipe for the purpose. The lighter cream, remaining near the center, is drawn out through another pipe. There is also a supply pipe so that the original milk can be run in while the machine is in operation.

Manufacture of Citric Acid

Question: How is citric acid made?—H. K.

Answer: Citric acid is made on a large scale from the juice of the lime and the lemon, chiefly in the months of November and December. The juice is fermented for some time, to free it from mucilage; then boiled, filtered, and neutralized with powdered chalk and a little milk of lime. The precipitate of calcium citrate so obtained is decomposed with dilute sulphuric acid; and the resulting

CONSULTING DEPARTMENT—(Continued)

solution of citric acid is separated by filtration, evaporated to remove calcium sulphate, and then concentrated in vacuum pans.

Velocity of Steam

Question: Could you give me the velocity of steam at different pressures—say 100 lbs., 200 lbs., 300 lbs., etc., up to 750 pounds, per square inch; or the rule or way to figure it out? The sizes of the holes are $\frac{3}{8}$ inch, $\frac{1}{2}$ inch, and $\frac{5}{8}$ inch in diameter.—A. H.

Answer: The flow of steam of greater pressure into an atmosphere of less pressure increases as the difference of pressure is increased, until the external pressure becomes only about 4-7 of the inside pressure. The flow is neither increased nor diminished by a difference of pressure greater than this ratio. When steam of varying initial pressures is discharged into the atmosphere, the atmosphere being not more than 4-7 of the initial pressure, the velocity of outflow at constant density is given by the formula $V = 3.595 \sqrt{h}$, in which V = the velocity of outflow, in feet per second, for steam of the initial density; h = height, in feet, of the column of steam of the given absolute initial pressure of uniform density, the weight of which is equal to pressure on the unit of base. Applying the above formula, the velocity for steam at 100 pounds absolute pressure will be nearly 900 feet per second. If the orifices are small, the velocity will not vary except with changes in the pressure.

Number of Lamps—Heating of Conductors

Question 1: What is the maximum number of incandescent lamps (220-ohm) which may be operated from one machine of 110 volts? Is the number limited only by internal resistance of machine and external resistance of mains?

Question 2: Is the heating effect upon a conductor, such as a trolley wire, greater or less when carrying an alternating current than a direct current?—P. H.

Answer 1: A 16-candle-power incandescent lamp at 110 volts has a resistance of about 220 ohms when hot, and takes a current of $\frac{1}{2}$ ampere. The number of

lamps that can be run is limited by the capacity of the generator. If the capacity of the generator is 100 amperes, you can operate 200 lamps from it. It is not a matter of internal resistance of the machine, but rather of current-carrying capacity of the armature conductors and of commutation without excessive sparking. Of course, the mains should have sufficient carrying capacity to handle the current without overheating.

Answer 2: The heating effect upon a conductor of an alternating current is the same as that of a direct current; that is, if a direct current of 100 amperes is flowing in a wire, the heating effect will be the same as that of an alternating current whose virtual or effective value is 100 amperes. This must be the case, because the virtual value of an alternating current is the value of an unvarying direct current which would produce the same heating effect.

Clearance Loss in Ammonia Compressor

Question 1: I should like to have you calculate the loss in ammonia compressor from following data: Compressor double-acting; size of cylinder, 15 inches by 23 inches' stroke; high pressure, 210 pounds; back pressure, 28 pounds; engine makes 60 r. p. m.; clearance, $\frac{1}{4}$ inch. This is very large, in fact too large a clearance, and the loss must be great. The machine is rated at 125 tons' refrigeration in 24 hours. With this large clearance, how much would it reduce refrigeration in 24 hours? Explain fully the loss per stroke, and per 24 hours.

Question 2: Would a spherical piston 17 inches in diameter have the same pressure (total pressure) exerted upon it as a flat piston?

Question 3: Give formula for finding area of a segment of a sphere 17 inches in diameter at base, height 9.5-16 inches.—R. H. K.

Answer 1: We have made calculations on the compressor, and find that the loss due to clearance is about 7 per cent. This is indeed excessive. Under the conditions of operation which you have given, it requires 2.81 cubic feet of gas to be passed through the compressor per minute, to produce one ton of refrigeration in 24 hours. Having allowed for the clearance, the compressor handles 264 cubic feet per minute; and consequently

CONSULTING DEPARTMENT—(Continued)

this equals 94 tons of refrigeration per 24 hours. This, you see, is considerably less than the rating. The loss per stroke is in the same proportion as the number of strokes per minute.

Answer 2: The pressure on the spherical piston of any diameter whatever is the same as the pressure on the flat piston of the same diameter.

Answer 3: The segment having but one base, multiply half the height of the segment by the area of the base, and the cube of the height by .5236, and add the two products.



Drop in Voltage

Question: Please explain how to figure the formula for the drop in voltage in electric wires for lighting. I know the formula, but do not know where you get it.—F. Z. W.

Answer: There are two common formulæ for figuring size of wires to supply direct current to a given number of incandescent lamps at a given distance.

The first formula is based on Ohm's law:

$$I = \frac{E}{R}$$

Then,

$$R = \frac{E}{I}$$

in which R is the resistance of the circuit; I, the current flowing; and E, the allowable drop in voltage.

Or, if R is to equal the resistance per foot, then we must multiply by L (the total length of circuit) to get the total resistance. In other words,

$$RL = \frac{E}{I}$$

Then,

$$R = \frac{E}{I \times L}$$

Now a 16-candle-power 110-volt lamp takes $\frac{1}{2}$ an ampere; hence, if N equals the number of lights, then,

$$I = \frac{N}{2}$$

And, if L equals the total length of circuit, and F equals the distance one way, then,

$$L = 2 F$$

Substituting these two values for I and L, we have:

$$R = \frac{E}{N \times F}$$

The second formula is based on the fact that the resistance of one foot of commercial copper wire one mil in diameter at a temperature of 75° F., is about 10.8 ohms. Then, since the resistance varies directly as the length and inversely as the area, we have:

$$R = \frac{10.8 \times L}{C M}$$

in which R is the resistance; L, the length; and C M, the area in circular mils. Then,

$$C M = \frac{10.8 \times L}{R}$$

but, as resistance equals electromotive force divided by current,

$$C M = \frac{10.8 \times L}{\frac{E}{I}} = \frac{10.8 \times L \times I}{E}$$



Horse-Power of Rotary Blower

Question: Please give rule for calculating the horse-power of a rotary blower. Is the following correct?—R. S. D.

$$H. P. = \frac{C. ft. \times 1,728 \times P. oz. \times N}{16 \times 33,000}$$

in which C. ft.=Cubic feet of blast per revolution; P oz.=Pressure of blast in ounces; and N=Revolutions per minute.

Answer: Your formula is incorrect, since you have made no allowance for the work necessary to give the air its velocity. The correct formula is:

$$H P = \frac{P Q}{33,000} + \frac{Q D}{2,125,000} V^2$$

in which P = Pressure of the air in the delivery pipe, in pounds per square foot; Q = Number of cubic feet of air discharged per minute; V = Velocity of air in discharge pipe in feet per second; and D = Density or weight of one cubic foot of air at the observed temperature and barometric pressure. The first term in this formula agrees practically with the formula you have given; that is, we have the factor of force P times the space per minute, which is Q, the number of cubic

CONSULTING DEPARTMENT—(Concluded.)

feet discharged per minute. The second term of the formula indicates that part of the power necessary to give the velocity, the work being determined by the formula $\frac{1}{2} m v^2$, m being the mass, and v the velocity in feet per second. Now, m , the mass, is equal to Weight divided by Gravity (g), so that it is equivalent to

$$\frac{W v^2}{2 g}$$

W = Number of cubic feet of air discharged per minute times the weight of each cubic foot, or $Q \times D$.

The above formula applies in cases where the air is drawn into the fan directly from the atmosphere. If there is a long suction pipe, the difference of pressure at inlet and exit is employed in obtaining P ; and the difference in the squares of the velocities must be employed, instead of V^2 .



Explosive Pressure of Gasoline

Question: I should like to know the increase of volume or pressure of a cubic foot of a well-mixed, properly proportioned charge of gasoline and air, just after ignition. Will a charge of air in gasoline ignite as readily under low pressure as under high?—*H. P. Jr.*

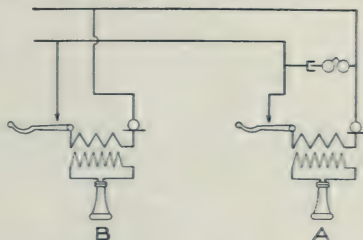
Answer: The constitution of the vapors of gasoline and other products of petroleum, is so complex and variable that the exact heating value of any certain vapor can be determined only by direct experiment. The heating value of a cubic foot of gasoline vapor is nearly 1,000 B. T. U., or about equal to the average natural gas. When mixed with the right proportion of air at atmospheric pressure, the maximum pressure due to explosion is about 100 pounds per square inch. The pressure attained under any circumstances, is only about one-half that which would be reached if the total heat of combustion were evolved at the instant of explosion. By compressing the mixture before explosion, much higher pressures can be reached.

The maximum pressure is not reached immediately after ignition, but a fraction of a second afterwards, the exact time depending upon the mixture and compression. The charge will not ignite as readily under low pressure as under high.

Circuit for Extension Telephone

Question: Will you please give me the outline of the circuits on an extension telephone, central-energy system, where there are but two wires running to the extension telephone?—*E. L. L.*

Answer: In this case, as we understand it, you have a telephone located somewhere in the room, as upon the wall, equipped complete with transmitter, receiver, and bell; and you wish to connect an extension telephone upon the line, obtaining your signals from the bell on the



first-mentioned phone. The accompanying sketch shows the proper connections, where A is the phone located upon the wall, and B is your extension desk telephone. If you wish a bell connected on your extension phone, it would simply be bridged across the line as shown in the connections for A.



Breaking Gauge Glass

Question: Will you please give me the cause and remedy for the following: At the last four boiler washings, I have taken out the drain nipple below the water glass, and swabbed out water glass with a small wad of waste on end of a thin pine stick. Now, in each case the glass burst. Last time, it cracked before steam was raised. The swab fits very loose, and I cannot assign any cause for it.—*H. B. H.*

Answer: The water glass is always a very frail piece of apparatus, and especially so when at a high temperature. Often, if the glasses are not lined up perfectly straight, they will break when slightly heated, owing to expansion and internal strains. Of course, if a glass is hot, nothing cold should be allowed to touch it. The only remedy is not to touch the glass unless this is absolutely necessary, and then to use care to see that the adjustment is not altered in any way.

GRADUATE AND STUDENT NOTES

A Word from Indo-China

MR. E. D. W. CHODYKO, of Haiphong, Tonkin, China, one of the American School students in the Far East, sends a very interesting article describing conditions in the French Indo-Chinese dependency of Tonkin, and the feeling there in regard to the present

sea harbor, Hong Gaye, whose roadstead is well sheltered and protected by a rocky coast.

Hong Gaye is also a military post and an important mining center. Here are located the most extensive coal mines in the country. Ships from the different nations are at all times loading coal by



PHOTO BY CLICHE DUFRESNE.

THE WHARVES AT HAIPHONG, LOOKING EAST.

Chief Seaport of the French Colonial Dependency of Tonkin, Indo-China.

war.. The letter was written in the first part of April, about a month and a-half after hostilities began, and it is full of interesting impressions as to the war.

The port of Haiphong, Mr. Chodyko describes as a river harbor, the deepening of which is not yet finished. Steamers and cruisers drawing not more than 24 feet of water, can secure safe anchorage. Big men-of-war and transports stay at the mouth of the river in a deep-

means of powerful hydraulic cranes, lifting half a car load of briquettes at a time.

Saigon, the capital of Cochin-China, is 10° south of Haiphong. It has a fine harbor, deep and large enough to receive any sized steamship or boat. At present there is a fleet of warships, cruisers, torpedo-boats, destroyers, and six submarines lying at anchor. Mr. Chodyko relates the following interesting fact:

"Last month Korea got left. Before the war, and this shows they were expecting it beforehand, it appears that the Korean Government, under the name of some private concern, ordered in France a lot of 75,000 old-style army rifles at a good bargain, as they

The dining saloon, in upper deck house, is a beautiful room. The finish is mahogany from deck to ceiling, and paneled in various shapes—staff ceiling, diamond forms, in the center of which



PHOTO BY CLICHE DUFRESNE.

A CHARACTERISTIC PORTION OF THE WATER-FRONT OF HAIPHONG, TONKIN.

were still new. Before the transport reached Haiphong, war was declared; and, upon her arrival in Haiphong, the ship was loaded with a cargo that had become war contraband, the 75,000 guns having been sent with a good lot of ammunition. The matter was put into the hands of the English Governor, who had the guns and the ammunition put ashore and locked up. Korea will have to wait until the war is finished to obtain her guns."

Shipbuilding at New London, Conn.

IN THE YARDS of the Eastern Ship Company, New London, Conn., two large steamships, the *Minnesota* and the *Dakota*, to run on the Pacific Ocean for the Great Northern Railway, are nearing completion.

Both ships are built the same size: Length, 630 ft.; breadth, 73 ft. 6 in.; depth to upper deck, 56 ft. All of the works and houses on the upper deck are shown white in the accompanying photograph. The gross tonnage of each ship is 21,000 tons. Both vessels will be fitted with all modern improvements—electric lights, and bathrooms with hot and cold fresh and salt water. All plumbing is open work, with nickel-plated pipes. The wood finish in passageways and around stair wells is very handsome. Oak, cherry, mahogany, birdseye maple, and cypress are among the woods used.

(every alternate one) is an opening for ventilation. Between these, in same line, are electric lights.

The vessels are twin-screw, and have two sets of engines, one on port, one on starboard side. The engines are vertical, triple-expansion, direct-acting, surface-condensing; high-pressure cylinder, 29 inches in diameter; intermediate, 51 inches diameter; low pressure, 89 inches diameter; stroke 57 inches; 16 boilers, 8 on each side, in sets of four. Steam pressure, 250 lbs.



LARGE STEAMSHIP BUILT AT NEW LONDON, CONN.

For the purpose of heating and ventilating the various parts of the vessels, staterooms, etc., large blowers and fans are employed—the blowers drawing the air through heaters, and forcing it around to the many outlets in passageways and rooms.

The coils in the heaters are so arranged that in warm weather cold water is cir-

culated through the pipes. By this means the air is cooled before being forced around the openings. The pipes for heating and ventilation are concealed as much as possible. The openings supplying heat are placed near the deck; and those for ventilating are near the ceiling.

The ventilation is both natural and mechanical. One particular feature in the heating and ventilation, is that no stateroom is supplied with heat directly. The lower portions of the doors are made of slat work, similar to blinds, but stationary. As every room has an opening for ventilation, the exhaust fans are drawing the air out of the rooms, and, to supply the deficiency in these rooms, the warm air from outside flows in through the slat work in the doors and results in a continual movement, or circulation, keeping the rooms comfortably heated.

be too happy to impart any information to those of our graduates, students, and readers who contemplate a visit to this beautiful "Island of Springs."

There are several points of interest which will delight the visitor, during his tour. He probably lands in Kingston (the capital), where he can be accommodated at Myrtle-Bank or Constant Spring Hotel. He is then at liberty to have a pleasant ride in an electric car, in any section of the town, for twopence.

He will naturally be anxious to visit the country, which he can do by rail, cutting obliquely across the island from Kingston to Montego Bay, a distance of 114 miles. The scenery is extremely wild, especially that viewed while running through the Cockpit mountains.

It is necessary to take a buggy from Montego Bay, in order to visit the north



ON THE ROAD TO BOG WALK, JAMAICA.

Openings are covered with brass-wire netting, or with face plates, like a register face. The difficulty of heating and ventilating and at the same time having no pipes in sight, can be appreciated only after taking a trip through these vessels.

The immense amount of work in the heating and ventilation of these steamships is shown by the fact that about forty tons of sheet iron was used on each vessel.—H. W. WASHBURN, American School Student.

A Letter from Jamaica

IT MAY BE of interest to our readers, to learn something of my "Island home"—Jamaica. Though far away from the American School of Correspondence, of which I am a student, I have its interest at heart; and should only

side of the island. The next town in order is Falmouth, which was well laid out but is now in a state of commercial depression. It is hoped that there will be a larger percentage of trade in a short time, as the harbor (which was very dangerous) has been very much improved by blasting and dredging, which is still in the hands of American engineers.

A few small towns of minor importance come next in order, until one reaches St. Ann's Bay, which is built on a decided slope to the sea. Four miles from this town, flows the Roaring river, with its beautiful falls resplendent with spray and white with foam.

The tourist will very likely be anxious to visit Port Antonio, center of the banana industry, the "American town" of Jamaica. This port has shipped thou-

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GRADUATE AND STUDENT NOTES—(Continued)

sands and thousands of stems of bananas to the United States, through the medium of the United Fruit Company, which has gained a firm foothold in the island, and which has been of great benefit to almost every section of the country.

Another point of interest is the Carambi Cave, in upper Trelawny, which



ON THE NORTH COAST ROAD, JAMAICA.

can be reached by taking the train to Balaclava Station and going thence by buggy a distance of 16 miles into the interior. The visitor can procure guides, who reside near the cave; they will take him through with torches—a distance of about two miles—where he will witness the wonderful work of nature in its varied display.—W. OSBORNE RUNCIE, American School Student.

Recently Graduated

THE FOLLOWING STUDENTS have been graduated from the American School of Correspondence since the last number of THE TECHNICAL WORLD was issued:

Adams, G. C., Winthrop, Me.—Course: Electrical.

Beerbower, Clyde, Salem, Va.—Course: Electrical.

Clifford, James A., Billings, Mont.—Course: Electrical Engineering.

Davison, C. H., Lyme, Conn.—Course, Stationary.

Dunn, J. Howard, Vanderbilt, Pa.—Course: Electrical.

Erskine, Harry, Johannesburg, South Africa.—Course: Mechanical.

Fogg, Jos., North Adams, Mass.—Course: Electrical.

Friedman, E. M., Bronson, Mich.—Course: Mechanical Drawing.

Fullmer, Geo. M., Saugerties, N. Y.—Course: Electrical.

Hauser, George, Milwaukee, Wis.—Course: Mechanical.

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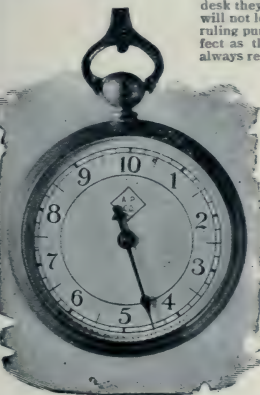
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not the old-fashioned stylo with a stiff needle or spring needle: it has just been patented and placed on the market. It is called the Gravity Stylo, and its name signifies the principle on which it works. It is only another instance of going back to Nature's laws to find success. One great advantage about these Stylos is that when left lying on the desk they are at their best; even if left there for several days without any cap on they will not leak and will be ready to write the instant the point touches the paper. For ruling purposes they are unequalled. Ruling done with a Stylo is as even and perfect as that done by machinery. If you have a Stylo you have a pencil that is always ready (just like a lead pencil), the advantage being that ink is used.



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Huck, John, Independence, La.—Course: Complete Mathematical.

Jessop, Edward, York, Pa.—Course: Mechanical.

Hetzler, G. E., Dayton, O.—Course: Electrical.

Kellar, John G., Albany, N. Y.—Course: Mechanical-Electrical.

Kylberg, Sylvester C., Wyoming, Milburn P. O., N. J.—Course: Mechanical-Electrical.

Langsdale, B. W., Kansas City, Mo.—Course: Mechanical Drawing.

Lindholm, John I., Bridgeport, Conn.—Course: Mechanical-Electrical.

Montgomery, E. G., Topeka, Kan.—Course: Heating, Ventilating, and Plumbing.

Osborn, Rex Elmer, Toledo, O.—Course: Mechanical-Electrical.

Petritsch, Jos., Chicago, Ill.—Course: Shop Practice.

Powers, Wm., Montreal, Que.—Course: Electrical.

Richardson, F. M. M., Nashville, Tenn.—Course: Mechanical-Electrical.

Wallace, John D., Chicago, Ill.—Course: Mechanical Engineering.

Winehold, Wm., Wadena, Ind.—Course: Locomotive.

Zito, James, Ft. Casey, Wash.—Course: Electrical.

Personal Notes

MR. MANGER, of Dawson City, Yukon Territory, writes that there is a regular stamped to the new Tanana placer diggings, that many of his friends are leaving for the newly discovered goldfields.

MR. R. W. COLLINS, of Monterey, Cal., writes: "I was at Salmos for a year, rebuilding a badly run down plant, but May 1st was transferred to the plant at this place, where I have been made Superintendent of the Company's work here and Chief Electrician of the other plants—the Salmos plant having been taken over by the above Company.

MR. C. W. DOUGLAS, of St. Louis, Mo., an American School student, is attending the summer school of the Armour Institute of Technology, and taking the courses in Mechanics and Electricity.

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PROF. WILLIAM ESTY, head of the Department of Electrical Engineering, Lehigh University: author of the section on Alternating Current Machinery.

H. C. CUSHING, Jr., Wiring Expert and Consulting Engineer: author of the section on Wiring for Light and Power.

PROF. DUGALD C. JACKSON, Collaborator with **PROF. GEORGE C. SHAAD**, University of Wisconsin: author of sections on Power Transmission, Electric Lighting and Central Stations.

J. R. CRAVATH, Western Editor of the Street Railway Journal: author of the section on Street Railways.

PROF. LOUIS DERR, Mass. Institute of Technology: **WILLIAM BOYERER**, Telephone Expert and Consulting Engineer; **CHAS. THOM**, Chief of Quadruplex Department Western Union Telegraph Co.: author of section on Telegraphy, and others.

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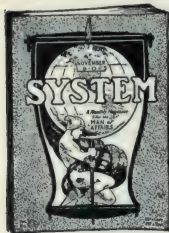
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GRADUATE AND STUDENT NOTES—(Continued)

TAZEWELL GILMER, Brooklyn, N. Y., has successfully passed the Civil Service Examination.

JOHN J. WHEELER, a graduate of the Armour Institute, Class of '97, in Mechanical Engineering, and at present enrolled in the American School in the Electrical Department, is Instructor at the Tuskegee (Ala.) Institute in Mechanical Engineering.



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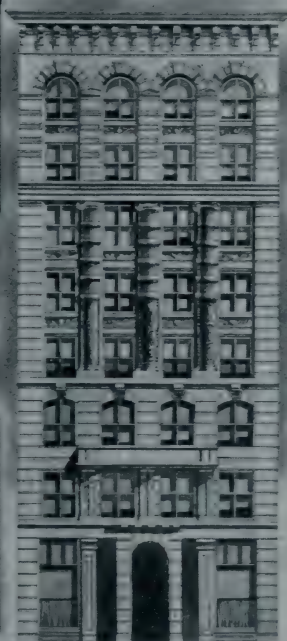
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An Error Corrected

THROUGH a misrepresentation of facts, the Editors of THE TECHNICAL WORLD were led—or rather misled—into making an erroneous statement in the August number regarding the designing and construction of the Citizens Building, Cleveland, O., ascribing the credit therefor to the wrong party. The architects of this structure were Messrs. Hubbell & Benes, who have their offices in the building; and THE TECHNICAL WORLD gladly takes this opportunity to correct the error.

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GRADUATE AND STUDENT NOTES—(Concluded)

On the Honor Roll

ON THE FOURTH OF JULY, Seymour J. Leighton, of Lawrence, Mass., a student of the American School, lost his life in an attempt to rescue two young girls who were out canoeing on the Merrimac river. The strong current carried the canoeing party over the dam to their death. Mr. Leighton, who had the reputation of being a powerful swimmer, sprang to the rescue. He had almost reached the upturned canoe, when his head struck one of the many rocks, and in a moment he had sunk from view, dead but a hero.

Mr. Leighton was an earnest student. The thoroughness of his work had won for him the esteem and respect of his instructors.



Poor Richard's Lament

BENJAMIN FRANKLIN had just drawn down the lightning from the clouds on his kite string.

"Great Kilowatts!" he muttered, scratching his head with tingling fingers, "What have I done? Already I foresee that ages yet unborn will refer to this afternoon's performance as a shocking experience!"



A NICKEL in the hand is worth two in the slot.—*Philadelphia Record.*



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WHEN the Jap navy heaves in sight, the Russians experience that sinking feeling.—*Life.*



SOME MEN figure their profits on paper, but the average coal dealer figures his on slate.—*Yonkers Statesman.*



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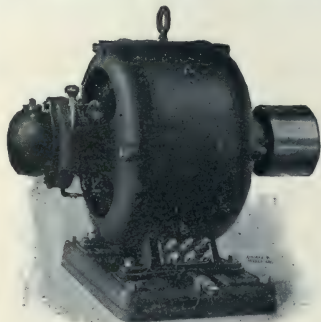
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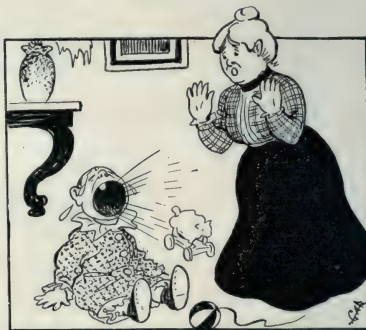
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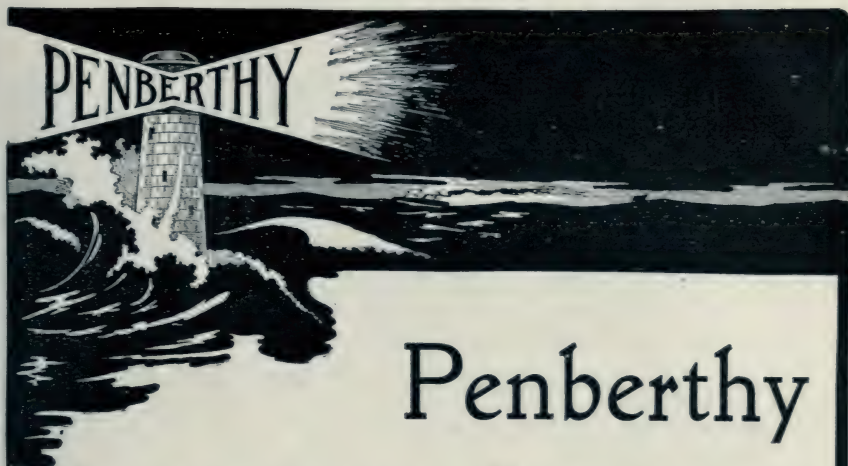
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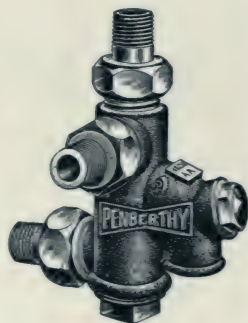
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Russia—Her Strength and Her Weakness. A Study of the Present Conditions of the Russian Empire, with an Analysis of its Resources and a Forecast of its Future. By Wolf von Schierbrand, Ph. D., author of "Germany—The Welding of a World-Power," "The Kaiser's Speeches," etc. Pages 304. Indexed. Maps. G. P. Putnam's Sons, New York. Price, \$1.60 net.

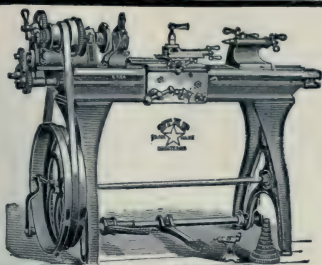
A MOST TIMELY book in view of the crisis with which Russia is now face to face. The hopelessness of the picture here presented is almost without one ray of light; and the significant thing about it is that the author has gathered his information largely at first hand, on the ground.

Another than the Czar has been called the "Sick Man of Europe," but Nicholas II. is entitled to the name—for either he is the inspiration, or he is the helpless tool, of that bureaucratic system of centralization which is as deadly a bane to the national life as is the hoof of the Sultan's horse to the grass upon which it treads. It is because Russia has been so inordinate in her ambition of expansion, and so ruthless in pursuit of her policy of "One flag, one language, one religion," that now in the hour of her trouble she finds but scant sympathy even among the chancelleries of Europe.

By "Russia" is here meant, of course, not the Russian people, but their overlords, for the peasantry are of sturdy

stock—the embryo, as it were, of a middle class such as, under more liberal governments, constitutes the main sinew of the national life, but which in Russia has never developed. It is in her *people* that the hope of Russia, and the strength of Russia—as indeed of every other nation—ultimately lies; and if her present chastisement shall serve the purpose of unlocking in any degree the yoke under which they have so long labored, the world at large will be benefited. The author might have brought out this point more strongly.

Russia is on a par with Turkey as a disturbing factor in international politics; and it is because of the large *x* involved in her problem, and the mystery with which she surrounds her counsels, that to the world's imagination her function as a world-power has been so exaggerated. According to Doctor von Schierbrand, her claims to strength rest solely on her enormous size. He finds the main cause of her intrinsic weakness in her persistent policy of territorial aggrandizement, which, through absorption of ever farther and farther outlying regions incapable of assimilation, multiplies her points of vulnerability and perennially drains her resources. Other serious canker-spots are the increasing ex-



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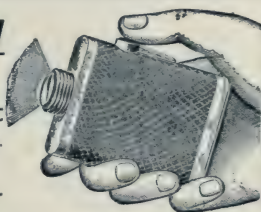
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The volume is well worthy of study.

Modern Air-Brake Practice, Its Use and Abuse. By Frank H. Dukessmith, M. E. Pages 300. Cloth. Illustrated. Indexed. Published by Frederick J. Drake & Co., Chicago, Ill. Price, \$1.50.

MOST BOOKS on the air-brake are in catechism form. This textbook is written in a general descriptive explanatory manner, the questions being grouped at the end of the sections. The author has divided the subject into three parts: First, the various parts of the air-brake, equipment, and functions; second, the various defects and their remedies; third, the handling of the brake, with tables and rules for computing brake power, leverage, etc. This book includes a short description of the "straight" air-brake as now used on electric railways, as well as the automatic air-brake on steam railroads. The volume has an excellent index, which enables one readily to find any subject desired.

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Boiler Construction. By Frank B. Kleinhans. Pages 421. Cloth. Illustrated. The Derry-Collard Company, New York, Publishers. Price, \$3.00.

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Boiler-Shop Machinery is illustrated by excellent half-tone engravings. Tables give valuable information regarding dies and punches, rate of driving rivets, etc.

Steel Square Pocket-Book. By Dwight L. Stoddard. Pages 110. Cloth. Illustrated. Industrial Publication Company, New York, Publishers. Price, 50 cents.

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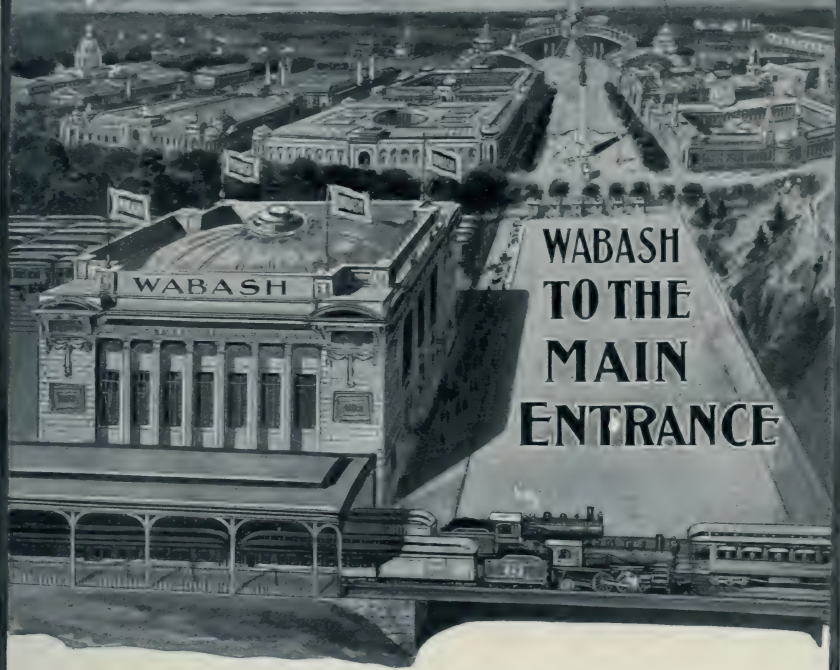
Steam and Electrical Engineering in Questions and Answers. By Spangenberg, Uhl, and Pratt. Cloth. Illustrated. Indexed. Pages 672. Geo. A. Zeller, St. Louis, Mo., Publisher. Price, \$3.50.

THIS REFERENCE BOOK for steam, electrical, and refrigerating engineers, is prepared in question-and-answer form, and includes stationary, locomotive, and electrical subjects, as well as mechanical refrigeration, compressed air, gas engines, hydraulic elevators, etc. The book endeavors to combine both theoretical and

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practical work, but even a slight examination indicates the strong tendency toward the practical. The names of the authors alone are sufficient to guarantee the practical usefulness of the volume. Prof. E. Spangenberg, C. E., was superintendent of the St. Louis School of Engineering, a man of wide practical experience and a successful teacher, especially in the preparation of men for license examinations. Mr. Albert Uhl, A. I. E. E., is an electrical contractor, and is instructor in practical electricity at the St. Louis School of Engineering. The third author, Mr. E. W. Pratt, is an expert on locomotive and railroad matters, being Master Mechanic of one of the large railways.

Telephone Principles and Practice. By George Wilder, Ph. D., Assistant Professor of Electrical Engineering, Armour Institute of Technology. Pages 445. Cantwell Publishing Company, Madison, Wis. Price, \$2.00, postpaid.

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LITERATURE—(Continued)

Magazines

Cassier's Magazine (August)—New York

THIS NUMBER contains as one of its most interesting features an article on Marble Quarrying in America, by D. A. Willey. Probably very few people know of the vast resources of the Vermont marble quarries, yet one enterprise alone produces from 60,000 to 70,000 tons annually. And from other deposits in this vicinity more marble is quarried than from all the other American quarries combined. This is interesting from a scientific standpoint, because practically all the work, from the quarrying of the marble to the finishing of the complete object, is done electrically and from power furnished by the Otter Creek. This same industry now gives employment to some 5,000 men and represents an investment of \$7,500,000. Not only is the marble furnished for rough and cheap grades of work, but the finished product ranges from the block for the building base to statues and vases, as well as interior decoration.

The mechanism for working in marble is so varied that a piece of the stone can be turned, planed, and routed as well as a piece of steel, entirely by power tools. The tool of the turning lathe is applied as in the ordinary metal turning lathe. Here can be seen circular columns weighing over 20 tons, exactly shaped by the power lathes. Also globes and tombstones containing ornaments in a bas-relief done with a planer. These machines are operated both by water power and by individual electric motors. The pneumatic chisel is an aid to the sculptor, who can create designs not only beautiful but extremely intricate in a small fraction of the time required with the mallet.

"Industrial Locomotives," by J. F. Gairns, treats the subject from the standpoint of compressed air and internal combustion. The writer states that it is probable that the compressed air locomotive would have been largely made use of if electricity had not provided a remedy for the disadvantages and inconvenience of the steam locomotive.

"The Study of Science," by John Brisbane Walker, shows conclusively how ab-

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LITERATURE—(Continued)

solutely essential is a scientific training to success in practically every sort of career.

The article on Amateur Engineering, by E. P. Watson, proves the expediency of placing an undertaking in the hands of a trained engineer rather than attempting to do the work oneself without the proper knowledge.

Other articles are:

Mineral Shipments at British Ports, by Brysson Cunningham, B. S.

Insulator Pins for Transmission Lines, by Alton D. Adams.

Specialized Machine Tools, by Joseph Horner.

Developing a Water Power, by Thorburn Reid.

Biographical Sketch of Edwin Wilbur Rice, Jr.

Municipal Engineering (August) — Indianapolis and New York

THE FIRST ARTICLE is on "Concrete-Steel Bridges at Dayton, Ohio." The concrete construction is becoming such an important factor in the building trades at the present time, that these articles are always read with great interest.

Another interesting article is on "Paving Materials," by John W. Alvord, C. E. In this article the writer gives an excellent description of the most common kinds of pavement, such as asphalt, stone pavement, brick, wood, macadam, and bitulithic.

The usual interesting departments—Question Department, Notes on Water Supply, Cement and Concrete, Streets and Lighting, Sewerage, etc.—are excellent.

Amateur Work (August)—Boston, Mass.

THE LEADING ARTICLES for this month's number of *Amateur Work* are along electrical lines, the first being "The Telegraph Transmitter," by Frederick A. Draper, which takes up a simple arrangement for transmitting messages.

The second article, on "Wireless Telegraph Apparatus," by Howard W. Rice, gives a few personal observations upon the interesting devices employed in space telegraphy.

"Telephone Circuits and Wiring," by Arthur H. Bell, is the third article along this line. A very interesting item is that

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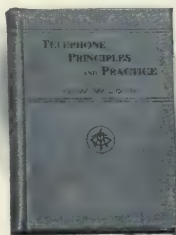
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LITERATURE—(Continued)

entitled "A Handy Combination," by R. G. Griswold. This tool is a combination of scroll or jig saw, a grinding and polishing attachment, and a drill.

Other articles are:

A Bench Grinder, by B. R. Wick (including Working Drawings).

Pattern-Making for Amateurs, No. VI, by F. W. Putnam.

Several articles on Photography.

Joints and Woodworking, by Frank Cecil Bain.

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Soldering, No. II, by H. M. Chadwick.

Catalogues

Jeffrey Manufacturing Company, Columbus, Ohio,
U. S. A. Bulletin No. 8. Pages 16. Paper, 8 by 10 inches.

THIS BULLETIN describes the general features and advantages of the Jeffrey Gathering Locomotives. The several illustrations show some of the types of Gathering Locomotives. They are made in different sizes, and are equipped with either one or two motors, dependent upon the weight of the locomotive. The distinctive feature of the electric gathering locomotive is that it may be operated over tracks where there is neither trolley wire nor steel rails. This is made possible by carrying upon the locomotive a reel of flexible, insulated conductor, which is operated by a friction-clutch positively driven by a silent running chain and sprocket from the motor, the control of the clutch being placed within easy reach of the motorman at the operating end of the locomotive.

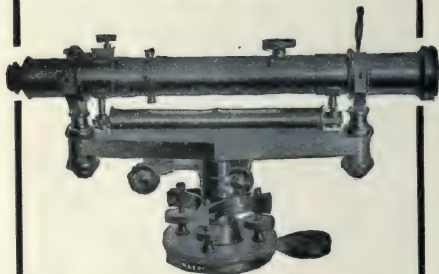
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Hetterschied Manufacturing Works, Grand Rapids, Mich. Pages 4. Paper, 5 1/2 by 9 inches.

THIS PAMPHLET gives illustrations and descriptions of three of this company's latest improved drawing tables, which are adapted for use in Drawing Schools, Public Schools, Manual Training Schools, Engineering Schools, etc. The tables are made entirely of metal, aside

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Thos. E. Clark Wireless Telegraph-Telephone Company, Pontiac, Mich. Pages 32. Paper, 7 by 10 inches.

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J. E. Snyder, Worcester, Mass. Pages 64. Paper, 6 by 9 inches.

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American Injector Company, Detroit, Mich. Pages 72. Paper, 3 1-2 by 6 inches.

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- One steel spring bow dividers, 3 3/4 inches long.
- One steel spring bow pen, 3 3/4 inches long, with needle point.
- One steel spring bow pencil, 3 3/4 inches long, with needle point.
- One 5-inch ruling pen, spring on upper Blade.
- One case with leads.
- One adjusting key.

Retail Price of Instruments, \$6.90

Total Value of Complete Outfit, \$14.49

DRAWING MATERIALS:

- One Drawing Board, 19x25 inches, seasoned pine, with hardwood ledges, attached to board by screws sunk in slots with metal bushings to allow for contraction or expansion. Shellac finish, - - - \$2.00
- One Mahogany T-Square, 24 in. long, ebony lined, fixed head, shellac finish, - - .90
- One 45° Transparent Triangle, 8 inch, - .75
- One 30x30° Transparent Triangle, 10 inch, .70
- One 12-inch Triangular Boxwood Scale, engine divided; graduated 3-32, 3-16, 1-8, 1-4, 3-8, 3-4, 1-2, 1 1/2, and 3 inches to the foot, and one edge inches and 16ths, with case, - - 1.00
- One Transparent Combination, Irregular or French Curve, special, - - 1.00
- One Bottle Higgins' Waterproof Ink, - .25
- One 4-H Siberian Drawing Pencil, - .10
- One Faber's Ink Eraser, No. 1075, - .05
- One Faber's Pencil Eraser, No. 111, - .05
- One dozen Thumbtacks, - - .20
- Nine sheets Whatman's handmade, cold pressed, Drawing Paper, 13 1/2 x 20 inches, .54
- Twelve sheets Whatstock Drawing Paper, 11x15 inches (for practice work only), - .15
- One Erasing Shield, - - .25
- One Sandpaper Block, - - .10
- One 6-inch German Silver Protractor, 1/2°, .90

Retail Price of Materials, - \$8.94

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ITS POSITION

“What are you anyway?” cries one more subscriber, who is merely the latest of a multitude. He wants it in black and white—Republican or Democratic.

Many letters wish to know why we are against the President, and as many more wish to know why we are for him. Some complain of our attacking Mr. Bryan, and others complain of our applauding him. We are called alternately plutocrat and demagogue.

It is not enough for us to say that Mr. Roosevelt is a good President, who has made some errors and some compromises; that Mr. Bryan represents some just ideals and some dangerous heresies; that Mr. Cleveland is a powerful figure, who has no great sympathy with the masses; that the Republicans have usually been plutocratic and the Democrats idiotic, and so on through the list of our opinions.

The average man dearly loves a label. Intellectually, he wishes to get somebody's collar on his neck.

It may be a limitation of our temperament, but we have no intention of giving our free thought into the charge of any party, or any faction of any party. We shall treat the President, Judge Parker, the Republicans, the Democrats, the East, the West, the South, exactly as may be called for by developments of the moment.

There is truth on every side, and falsehood, and our function is to expose falsehood and expound truth, wherever it may be, as far as we are able.—*Editorial, July 30, 1904.*